TRENDS.EARTH
tracking land change

Trends.Earth Documentation

Release 0.56

Conservation International

Apr 09, 2018

About

I About 3

1 About 5
1.1 Contacting the team . . . 5
1.2 Authors . . . 5
1.3 Acknowledgements . . . 6
1.4 License . . . 6

2 Data sources 7
2.1 NDVI . . . 7
2.2 Soil moisture . . . 7
2.3 Precipitation . . . 7
2.4 Evapotranspiration . . . 8
2.5 Land cover . . . 8
2.6 Soil carbon . . . 8
2.7 Agroecological Zones . . . 8
2.8 Administrative Boundaries . . . 8

3 Frequently asked questions 9
3.1 General Questions . . . 9
3.2 Installation of . . . 9
3.3 Datasets . . . 10
3.4 Methods . . . 10
3.5 Land degradation outputs . . . 11
3.6 Workshops . . . 12
3.7 Future plans . . . 12

4 Development 13

II Background 15

5 SDG Indicator 15.3.1 17
5.1 Sub-indicators . . . 18
5.2 Combining indicators . . . 24

6 Before installing the toolbox 27

7 Installing the toolbox 29
7.1 Installing the stable version (recommended) . . . 29
7.2 Installing the development version (advanced users) . . . 30

III Documentation 31

8 Registration and settings 33
8.1 Registration . . . 33
8.2 Updating your user . . . 35
8.3 Forgot password . . . 36

9 Calculate indicators 39
9.1 Calculate indicators with simplified tool . . . 40
9.2 Calculate productivity . . . 45
9.3 Calculate land cover . . . 50
9.4 Calculate soil carbon . . . 55
9.5 Compute SDG Indicator 15.3.1 . . . 60

10 Plot data 67

11 Download data 73

12 View and download results 75

13 Visualization tools 79

14 Load data tool 83
14.1 Load a dataset produced by Trends.Earth . . . 83
14.2 Load a custom input dataset . . . 89

15 About 93

IV Step-by-step guides 95

16 Installation and Registration 97

17 Run 1-step subindicators 103

18 Task status & download 113
18.1 OPTIONAL: Computing Pyramids . . . 117

19 Use custom productivity data 121

20 Use custom land cover data 129

21 Use custom soil data 147
21.1 Loading custom soil organic carbon data . . . 147
21.2 Calculating soil organic carbon with custom data . . . 154

22 Load results and basemap 161
22.1 Adding a basemap . . . 165

23 Compute SDG indicator 169

24 Interpreting summary table 177

V Videos 183

25 Video Overviews 185

TRENDS.EARTH
tracking land change

English	Español	Francais				Swahili	Português

Trends.Earth (formerly the Land Degradation Monitoring Toolbox) is a platform for monitoring land change using earth observations in an innovative desktop and cloud-based system.

The three sub-indicators for monitoring achievement of Land Degradation Neutrality (LDN, Sustainable Development Goal (SDG) Target 15.3), are supported by TRENDS.EARTH: productivity, land cover, and soil organic carbon. The tool also supports countries in analyzing data to prepare for their reporting committments to the United Nations Convention to Combat Desertification (UNCCD).

Trends.Earth allows users to plot time series of key indicators of land change (including degradation and improvement), to produce maps and other graphics that can support monitoring and reporting, and to track the impact of sustainable land management or other projects.

See the general fact sheet or technical fact sheet for further information.

The documentation and training materials, including a number of demonstration videos, are available on this website:

- About
- Background information
- Documentation
- Step-by-step Guides
- Videos

Note: Download this documentation as a PDF for offline use

Part I

About

CHAPTER 1

About

TRENDS.EARTH was produced as part of the project "Enabling the use of global data sources to assess and monitor land degradation at multiple scales", funded by the Global Environment Facility.

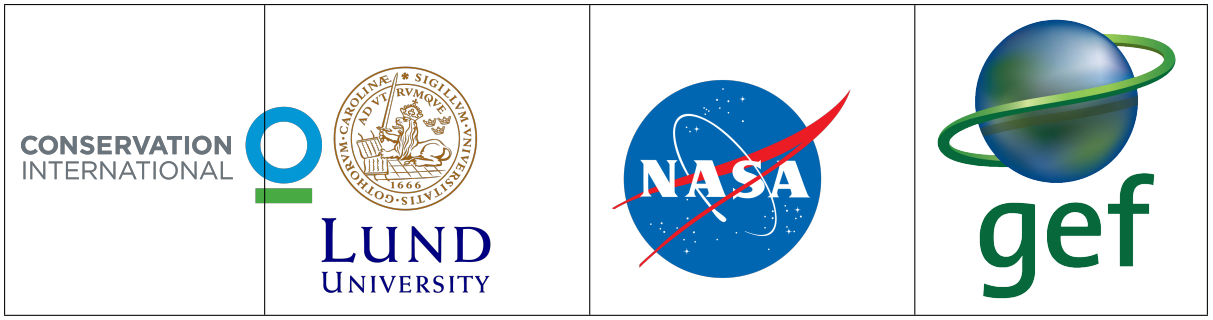
1.1 Contacting the team

Contact the trends.earth team with any comments or suggestions. If you have specific bugs to report or improvements to the tool that you would like to suggest, you can also submit them in the issue tracker on Github for TRENDS.EARTH.

1.2 Authors

The Land Degradation Monitoring Project is a partnership of Conservation International, Lund University, and the National Aeronautics and Space Administration (NASA), and is funded by the Global Environment Facility (GEF).

Contributors to the documentation and to TRENDS.EARTH include Yengoh Genesis, Lennart Olsson, Mariano Gonzalez-Roglich, Monica Noon, Tristan Schnader, Anna Tengberg, and Alex Zvoleff.



TRENDS.EARTH uses Google Earth Engine to compute indicators in the cloud.

Google Earth Engine

1.3 Acknowledgements

The feedback provided by early users of TRENDS.EARTH and by the participants in the webinars and workshops held by the GEF Land Degradation Monitoring Project have been critical to the development of the tool.

Neil Sims, Sasha Alexander, Renato Cumani, and Sara Minelli provided input on the implementation of the SDG 15.3 and LDN indicators in TRENDS.EARTH, on the structure of the tool, and on the UNCCD reporting process, and also provided early input and testing of the tool.

The project acknowledges the participants of the workshop held in Morogoro, Tanzania in October, 2017 for sharing their feedback and suggestions on the tool: Jones Agwata, Col. Papa Assane Ndiour, Lt. Fendama Baldé, Papa Nékhou Diagne, Abdoul Aziz Diouf, Richard Alphonce Giliba, Moses Isabirye, Vettes Kalema, Joseph Kihaule, Prof. D.N. Kimaro, James Lwasa, Paulo Mandela, Modou Moustapha Sarr, Joseph Mutyaba, Stephen Muwaya, Joseph Mwalugelo, Prof. Majaliwa Mwanjalolo, Edson Aspon Mwijage, Jerome Nchimbi, Elibariki Ngowi, Tabby Njunge, Daniel Nkondola, Blaise Okinyi, Joseph Opio, Rozalia Rwegasira, Ndeye Kany Sarr, Mamadou Adama Sarr, Edward Senyonjo, Olipa Simon, Samba Sow, Felly Mugizi Tusiime and John Wasige.

1.4 License

TRENDS.EARTH is free and open-source. It is licensed under the GNU General Public License, version 2.0 or later.

This site and the products of TRENDS.EARTH are made available under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0). The boundaries and names used, and the designations used, in TRENDS.EARTH do not imply official endorsement or acceptance by Conservation International Foundation, or its partner organizations and contributors.

CHAPTER 2

Data sources

TRENDS.EARTH draws on a number of data sources. The data sets listed below are owned/made available by the following organizations and individuals under separate terms as indicated in their respective metadata.

2.1 NDVI

Sensor/Dataset	Temporal	Spatial	Extent	License
AVHRR/GIMMS	1982-2015	8 km	Global	Public Domain
MOD13Q1-coll6	2001-2016	250 m	Global	Public Domain

2.2 Soil moisture

Sensor/Dataset	Temporal	Spatial	Extent	License
MERRA 2	1980-2016	0.5° x 0.625°	Global	Public Domain
ERA I	1979-2016	0.75° x 0.75°	Global	Public Domain

2.3 Precipitation

Sensor/Dataset	Temporal	Spatial	Extent	License
GPCP v2.3 1 month	1979-2016	2.5° x 2.5°	Global	Public Domain
GPCC V7	1901-2016	1° x 1°	Global	Public Domain
CHIRPS	1981-2016	5 km	50N-50S	Public Domain
PERSIANN-CDR	1983-2015	25 km	60N-60S	Public Domain

2.4 Evapotranspiration

Sensor/Dataset	Temporal	Spatial	Extent	License
MOD16A2	2000-2014	1 km	Global	Public Domain

2.5 Land cover

Sensor/Dataset	Temporal	Spatial	Extent	License
ESA CCI Land Cover	1992-2015	300 m	Global	CC by-SA 3.0

2.6 Soil carbon

Sensor/Dataset	Temporal	Spatial	Extent	License
Soil Grids (ISRIC)	Present	250 m	Global	CC by-SA 4.0

2.7 Agroecological Zones

Sensor/Dataset	Temporal	Spatial	Extent	License
FAO - IIASA Global Agroecological Zones (GAEZ)	2000	8 km	Global	Public Domain

2.8 Administrative Boundaries

Sensor/Dataset	Temporal	Spatial	Extent	License
Natural Earth Administrative Boundaries	Present	10/50m	Global	Public Domain

Note: The Natural Earth Administrative Boundaries provided in Trends.Earth, are in the public domain. The boundaries and names used, and the designations used, in Trends.Earth do not imply official endorsement or acceptance by Conservation International Foundation, or by its partner organizations and contributors.

If using Trends.Earth for official purposes, it is recommended that users choose an official boundary provided by the designated office of their country.

CHAPTER 3

Frequently asked questions

This page lists some Frequently Asked Questions (FAQs) for the TRENDS.EARTH tool.

3.1 General Questions

How do I find more information on the project?

More information on the toolbox can be found at trends.earth and reports are available on the Vital Signs Project website You can also add your contact info at Vital Signs LD Email Distribution List to stay in touch with any advancements with the projects' distrubtion list.

How can I provide feedback on the tool?

There are three ways to give feedback, emailing the project team, visiting the project site and messaging through the anonymous form or rate the toolbox in the plugins menu of QGIS. The project technical team can address questions through trends.earth@conservation.org. Users can rate the toolbox by opening Plugins in QGIS and selecting Manage and Install Plugins. Select All in the side bar and navigate to trends.earth plugin. Click on trends.earth and rate the toolbox by selecting the number of stars you would like to give the plugin, 5 stars being highly satisfied.

3.2 Installation of TRENDS.EARTH

What version of Quantum GIS (QGIS) do I need for the toolbox?

To download QGIS, please go to the QGIS Downloads page. As of February 2018, version 3.0 was released. Please use version 2.18 for the trends.earth plugin. A version compatible with the latest version will be released in future iterations of the project.

Do I need to download a 32-bit or 64 bit version of QGIS?

We recommend downloading 64-bit version (2.18), but you may need to download the 32-bit version for 32-bit operating systems. To find out if your computer is running a 32-bit or 64-bit version of Windows, search for System or msinfo32. This is found in the Control Panel and will bring up a window that says the system type e.g. System type: 64-bit Operating System, x64-based processor.

Windows 7 or Windows Vista:

1. Open System by clicking the Start button , right-clicking Computer, and then clicking Properties.

2. Under System, you can view the system type.

Windows 8 or Windows 10:

1. From the Start screen, type This PC.
2. Right Click (or tap and hold) This PC, and click Properties.

Mac:

1. Click the Apple icon in the top left and select "About this Mac".
2. For more advanced details click "More Info..." in the About This Mac window.

How do I install the plugin?

Open QGIS, navigate to Plugins on the menu bar, and select Manage and install plugins. On the side menu, select All to view the plugins available in QGIS. Search for trends.earth and select Install plugin at the bottom of the window.

How do I upgrade the plugin?

If you have already installed the plugin, navigate to Plugins on the menu bar, and select Manage and install plugins. On the side menu, select Installed to view the plugins that you have installed in your computer. At the bottom of the window, select Upgrade all to upgrade the toolbox to the latest version.

3.3 Datasets

When will you update datasets for the current year?

Trends.Earth uses publicly available data, as such the most up to date datasets will be added to the toolbox as soon as the original data providers make them public. If you notice any update that we missed, please do let us know.

Is there an option to download the original data?

Users can download the original data using the Download option within the toolbox.

Will the toolbox support higher resolution datasets?

The toolbox currently supports AVHRR (8km) and MODIS (250m) data for primary productivity analysis, and ESA LCC CCI (300m) for land cover change analysis.

Can the toolbox support analysis with national-level datasets?

This is a common request from users, and one the team is working on. Trends.Earth will allow loading of national-level soil carbon and land cover datasets before the end of March, 2018. This will allow users to take advantage of existing datasets that might be of higher quality at a national-level than the global datasets that are the defaults in the tool.

3.4 Methods

Who was the default time period for the analysis determined?

The default time period of analysis is from years 2001 to 2015. These were recommended by the Good Practice Guidelines., a document that provides detailed recommendations for measuring land degradation and has been adopted by the UNCCD.

3.4.1 Productivity

How does the result provided by state differs from trajectory?

The trajectory analysis uses linear regressions and non-parametric tests to identify long term significant trends in primary productivity. This method however, is not able to capture more recent changes in primary productivity, which could be signals of short term processes of improvement or degradation. By comparing a long term mean to the most recent period, state is able to capture such recent changes.

3.4.2 Land cover

Currently, the land cover aggregation is done following the UNCCD guidelines, but that classification does not take into account country level characteristics. Could it be possible to allow the user to define the aggregation criteria?

Users are able to make these changes using the advanced settings in the land cover GUI so that appropriate aggregations occur depending on the context of your country.

How can we isolate woody plant encroachment within the toolbox?

This can be altered using the land cover change matrix in the toolbox. For every transition, the user can mark the change as stable, improvement or degraded. The transition from grassland/rangeland to shrubland may indicate woody encroachment and this transition can be marked as an indicator of degradation.

3.4.3 Carbon stocks

Why use soil organic carbon (SOC) instead of above and below-ground carbon to measure carbon stocks?

The original proposed indicator is Carbon Stocks, which would include above and below ground biomass. However, given the lack of consistently generated and comparable dataset which assess carbon stocks in woody plants (including shrubs), grasses, croplands, and other land cover types both above and below ground, the Good Practice Guidelines published by the UNCCD recommends for the time being to use SOC as a proxy.

Is it possible to measure identify processes of degradation linked to salinization using this tool?

Not directly. If salinization caused a reduction in primary productivity, that decrease would be identified by the productivity indicators, but the users would have to use their local knowledge to assign the causes.

3.5 Land degradation outputs

How were the layers combined to define the final land degradation layer?

Performance, state, and trajectory (the three indicators of change in productivity) are combined following a modified version of the good practice guidance developed by the UNCCD (in section SDG Indicator 15.3.1 of this manual a table is presented). Productivity, soil carbon, and land cover chance (the three sub-indicators of SDG 15.3.1) are combined using a "one out, all out" principle. In other words: if there is a decline in any of the three indicators at a particular pixel, then that pixel is mapped as being "degraded".

Why do I see areas improving (in green) or degrading (in red) after the final analysis when I know they are not?

The final output should be interpreted as showing areas potentially degraded. The indicator of land degradation is based on changes in productivity, land cover and soil organic carbon. Several factor could lead to the identification of patterns of degradation which do not seem to correlate to what is happening on the ground, the date of analysis being a very important one. If the climatic conditions at the beginning of the analysis were particularly wet, for example, trends from that moment on could show significant decreases in primary productivity, and degradation. The user can use Trends.Earth to address some of this issues correcting by the effect of climate. The resolution of the data could potentially be another limitation. Trends.Earth by default uses global datasets which will not be the most relevant at all scales and geographies. A functionality to use local data will be added shortly.

All of the sub-indicators are measuring vegetation using three different methods: how does this contribute to understanding and identifying land degradation?

Vegetation is a key component of most ecosystems, and serve as a good proxy for their overall functioning and health. The three subindicators used for SDG 15.3.1 measure different aspects of land cover, which do relate to vegetation. Primary productivity directly measures the change in amount of biomass present in one area, but it does not inform us if that change is positive or not (not all increases in plant biomass should be interpreted as improvement). Land cover fills that gap by interpreting the landscape from a thematic perspective looking at what was there before and what is there now. It does include vegetation, but also bare land, urban and water. Finally, the soil organic carbon indicator uses the land cover map to inform the changes in soil organic carbon over time. This method is not ideal, but given the current state of global soil science and surveying, there is consensus that it this point in time and globally, this is the best approach.

3.6 Workshops

Will the project offer future training opportunities so users can continues working with the tool?

The project is working with the UNCCD to support their work training users on monitoring and reporting in support of countries' national-level responsibilities under the convention. These trainings will be occurring in March-April 2018. In addition, the project will work with key stakeholders, such as RCMRD, to provide support through existing platforms. The project will also continue to make e-learning materials available to users, and is considering potential funding sources for further capacity-building activities in East Africa.

3.7 Future plans

When will there be an offline version of the toolbox?

The final toolbox will be available as both as an offline and online version. The online version allows users to access current datasets more easily, while also allowing users to leverage Google Earth Engine to provide computing in the cloud. An offline version allows users to access data and perform analyses where internet connectivity may be limited, but it does have the disadvantage of requiring users to have enough local computing capacity to run analyses locally. The technical team intends to build the offline version of the toolbox and provide countries with data relevant for reporting at the national level within the pilot project countries.

Will you create a trends.earth toolbox for ESRI users?

The toolbox is currently available as a plugin to QGIS, an open source software package. This allows users around the world free access to the toolbox. There are currently no plans to build a toolbox within ArcGIS or ArcPro.

CHAPTER 4

Development

TRENDS.EARTH is free and open-source software, licensed under the GNU General Public License, version 2.0 or later.

There are a number of components to the TRENDS.EARTH tool. The first is a QGIS plugin supporting calculation of indicators, access to raw data, reporting, and production of print maps . The code for the plugin, and further instructions on installing it if you want to modify the code, are in trends.earth github repository.

The TRENDS.EARTH QGIS plugin is supported by a number of different Python scripts that allow calculation of the various indicators on Google Earth Engine (GEE). These scripts sit in the "gee" subfolder of that github repository.

The GEE scripts are supported by the landdegradation Python module, which includes code for processing inputs and outputs for the plugin, as well as other common functions supporting calculation of NDVI integrals, statistical significance, and other shared code. The code for this module is available in the landdegradation repository on Github.

Part II

Background

CHAPTER 5

SDG Indicator 15.3.1

As part of the "2030 Agenda for Sustainable Development", Sustainable Development Goal (SDG) 15 is to:

> "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss"

Each SDG has specific targets addressing different components, in this case, of life on land. Target 15.3 aims to:

> "By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world"

Indicators will be used then to assess the progress of each SDG target. In the case of SDG 15.3 the progress towards a land degradation neutral world will be assessed using indicator 15.3.1:

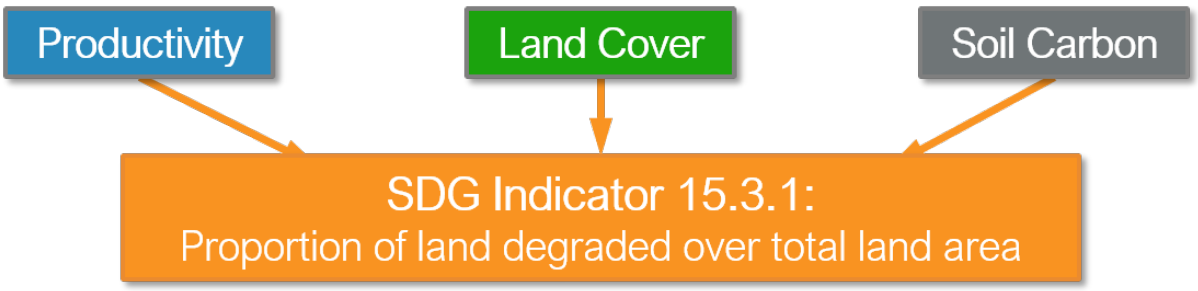
> "proportion of land that is degraded over total land area"

As the custodian agency for SDG 15.3, the United Nations Convention to Combat Desertification (UNCCD) has developed a Good Practice Guidance (GPG). providing recommendations on how to calculate SDG Indicator 15.3.1.

This document provides a brief introduction to SDG Indicator 15.3.1 and describes how each indicator is calculated by TRENDS.EARTH.

In order to assess the area degraded, SDG Indicator 15.3.1 uses information from 3 sub-indicators:

1. Vegetation productivity
2. Land cover
3. Soil organic carbon



TRENDS.EARTH allows the user to compute each of these subindicators in a spatially explicit way generating raster maps which are then integrated into a final SDG 15.3.1 indicator map and produces a table result reporting areas potentially improved and degraded for the area of analysis.

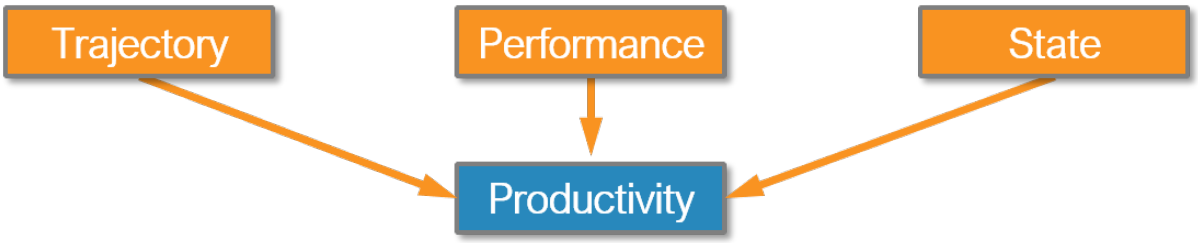
5.1 Sub-indicators

5.1.1 Productivity

Land productivity is the biological productive capacity of the land, the source of all the food, fiber and fuel that sustains humans (United Nations Statistical Commission 2016). Net primary productivity (NPP) is the net amount of carbon assimilated after photosynthesis and autotrophic respiration over a given period of time (Clark et al. 2001) and is typically represented in units such as kg/ha/yr. NPP is a variable time consuming and costly to estimate, for that reason, we rely on remotely sensed information to derive indicators of NPP.

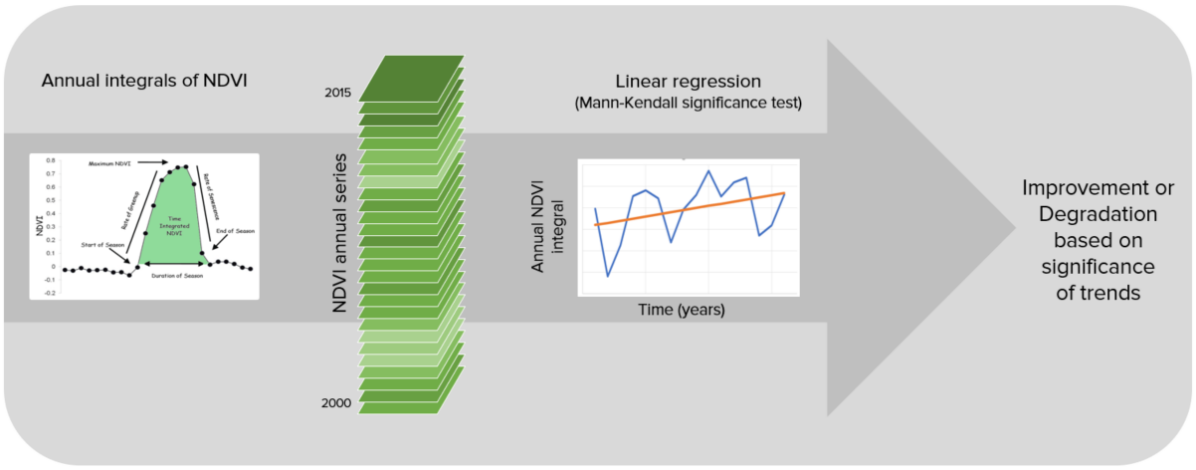
One of the most commonly used surrogates of NPP is the Normalized Difference Vegetation Index (NDVI), computed using information from the red and near infrared portions of the electromagnetic spectrum. In TRENDS.EARTH we make use of bi-weekly products from MODIS and AVHRR to compute annual integrals of NDVI (computed as the mean annual NDVI for simplicity of interpretation of results). These annual integrals of NDVI are then used to compute each of the productivity indicators explained below.

Land productivity is assessed in TRENDS.EARTH using three measures of change derived from NDVI time series data: trajectory, performance and state



Productivity Trajectory

Trajectory measures the rate of change in primary productivity over time. As indicated in the figure below, TRENDS.EARTH computes a linear regression at the pixel level to identify areas experiencing changes in primary productivity for the period under analysis. A Mann-Kendall non-paremetric significance test is then applied, considering only significant changes those that show a p-value 0.05. Positive significant trends in NDVI would indicate potential improvement in land condition, and negative significant trends potential degradation.



Correcting for the effects of climate

Within a given ecosystem, primary productivity is affected by several factors, such as temperature, and the availability of light, nutrients and water. Of those, water availability is the most variable over time, and can have very significant influences in the amount of plant tissue produced every year. When annual integrals of NDVI are used to perform the trajectory analysis, it is important to interpret the results having historical precipitation information as a context. Otherwise, declining productivity trends could be identified as human caused land degradation, when they are driven by regional patterns of changes in water availability.

TRENDS.EARTH allows the user to perform different types of analysis to separate the climatic causes of the changes in primary productivity, from those which could be a consequence of human land use decisions on the ground. The methods currently supported for climate corrections are:

Residual Trend Analysis (RESTREND): RESTREND uses linear regression models to predict NDVI for a given rainfall amount. Trends in the difference between the predicted NDVI and the observed NDVI (the residual) are interpreted as non-climatically related productivity change. Please refer to the following citation more more details on the method and its limitations: Wessels, K.J.; van den Bergh, F.; Scholes, R.J. Limits to detectability of land degradation by trend analysis of vegetation index data. Remote Sens. Environ. 2012, 125, 10–22.

Rain Use Efficiency (RUE): RUE Is the ratio of annual NPP to annual precipitation. TRENDS.EARTH uses the annual integrals of NDVI as a proxy for annual NPP, and offers the possibility of choosing among different precipitation products to compute RUE. After RUE is computed for each of the years under analysis, a linear regression and a non-parametric significance test is applied to the trend of RUE over time. Positive significant trends in RUE would indicate potential improvement in land condition, and negative significant trends potential degradation. Please refer to the following publication for details on the methods and its limitations: Wessels, K.J.; Prince, S.D.; Malherbe, J.; Small, J.; Frost, P.E.; VanZyl, D. Can human-induced land degradation be distinguished from the effects of rainfall variability? A case study in South Africa. J. Arid Environ. 2007, 68, 271–297.

Water Use Efficiency (WUE): RUE assumes that there is a linear relationship between the amount of water that falls in the form of precipitation in a particular place and the amount of water which will be actually used by the plants. This assumption does not hold true for every system. WUE tries to address this limitation by using total annual evapo-transpiration (ET) instead precipitation. ET is defined as precipitation minus the water lost to surface runoff, recharge to groundwater and changes to soil water storage. The rest of the analysis follows as described for RUE: a linear regression and a non-parametric significance test is applied to the trend of WUE over time. Positive significant trends in WUE would indicate potential improvement in land condition, and negative significant trends potential degradation.

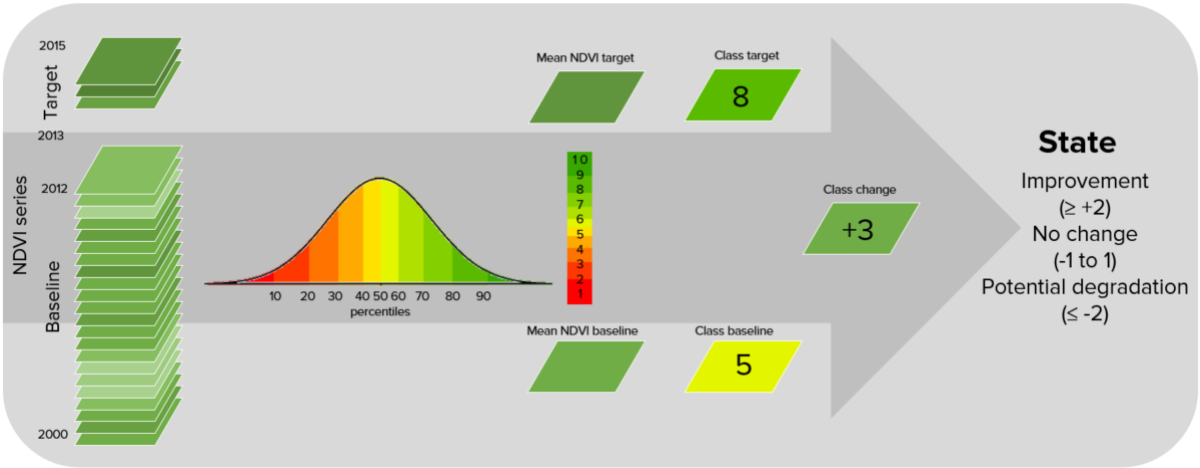
The table below list the datasets available in TRENDS.EARTH to perform NDVI trend analysis over time using the original NDVI data or with climatic corrections:

Variable	Sensor/Dataset	Temporal	Spatial	Extent	Units/Description
NDVI	AVHRR/GIMMS	1982-2015	8 km	Global	Mean annual NDVI * 10000
	MOD13Q1-coll6	2001-2016	250 m	Global	Mean annual NDVI * 10000
Soil moisture	MERRA 2	1980-2016	0.5 ° x 0.625 °	Global	Water root zone m^3m^{-3} * 10000
	ERA I	1979-2016	0.75 ° x 0.75 °	Global	Volumetric Soil Water layer m^3m^{-3} (0-7 cm)
Precipitation	GPCP v2.3 1 month (Global Precipitation Climatology Project)	1979-2016	2.5° x 2.5°	Global	mm/year
	GPCC V7 (Global Precipitation Climatology Centre)	1901-2016	1° x 1°	Global	mm/year
	CHIRPS	1981-2016	5 km	50N-50S	mm/year
	PERSIANN-CDR	1983-2015	25 km	60N-60S	mm/year
Evapotranspiration	MOD16A2	2000-2014	1 km	Global	Annual ET km/m2 (=mm) * 10

Productivity State

The Productivity State indicator allows for the detection of recent changes in primary productivity as compared to a baseline period. The indicator is computed as follows:

1. Define the baseline period (historical period to which to compare recent primary productivity).
2. Define the comparison period (recent years used to compute comparison). It is recommended to use a 3-year to avoid annual fluctuations related to climate.
3. For each pixel, use the annual integrals of NDVI for the baseline period to compute a frequency distribution. In case the baseline period missed some extreme values in NDVI, add 5% on both extremes of the distribution. That expanded frequency distribution curve is then used to define the cut-off values of the 10 percentile classes.
4. Compute the mean NDVI for the baseline period, and determine the percentile class it belongs to. Assign to the mean NDVI for the baseline period the number corresponding to that percentile class. Possible values range from 1 (lowest class) to 10 (highest class).
5. Compute the mean NDVI for the comparison period, and determine the percentile class it belongs to. Assign to the mean NDVI for the comparison period the number corresponding to that percentile class. Possible values range from 1 (lowest class) to 10 (highest class).
6. Determine the difference in class number between the comparison and the baseline period (comparison minus baseline).
7. If the difference in class between the baseline and the comparison period is 2, then that pixel could potentially be degraded. If the difference is 2, that pixel would indicate a recent improvement in terms of primary productivity. Pixels with small changes are considered stable.



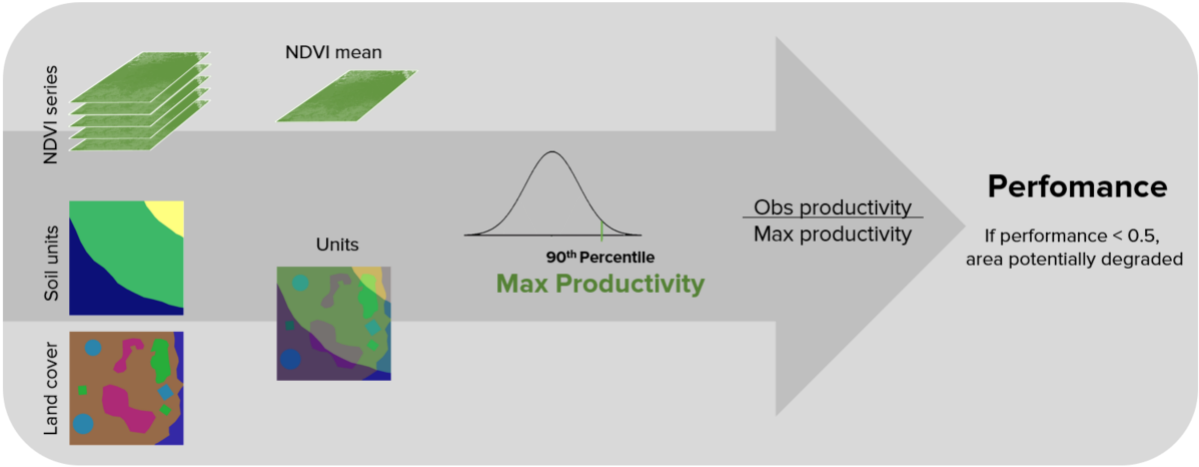
The table below list the datasets available in TRENDS.EARTH to compute the Productivity State indicator:

Variable	Sensor/Dataset	Temporal	Spatial	Extent	Units/Description
NDVI	AVHRR/GIMMS	1982-2015	8 km	Global	Mean annual NDVI * 10000
	MOD13Q1-coll6	2001-2016	250 m	Global	Mean annual NDVI * 10000

Productivity Performance

The Productivity Performance indicator measures local productivity relative to other similar vegetation types in similar land cover types or bioclimatic regions throughout the study area. TRENDS.EARTH uses the unique combination of soil units (soil taxonomy units using USDA system provided by SoilGrids at 250m resolution) and land cover (full 37 land cover classes provided by ESA CCI at 300m resolution) to define this areas of analysis. The indicator is computed as follows:

1. Define the analysis period, and use the time series of NDVI to compute mean the NDVI for each pixel.
2. Define similar ecologically similar units as the unique intersection of land cover and soil type.
3. For each unit, extract all the mean NDVI values computed in step 1, and create a frequency distribution. From this distribution determine the value which represents the 90th percentile (we don't recommend using the absolute maximum NDVI value to avoid possible errors due to the presence of outliers). The value representing the 90th percentile will be considered the maximum productivity for that unit.
4. Compute the ratio of mean NDVI and maximum productivity (in each case compare the mean observed value to the maximum for its corresponding unit).
5. If observed mean NDVI is lower than 50% than the maximum productivity, that pixel is considered potentially degraded for this indicator.



The table below list the datasets available in TRENDS.EARTH to compute the Productivity Performance indicator:

Variable	Sensor/Dataset	Temporal	Spatial	Extent	Units/Description
NDVI	AVHRR/GIMMS	1982-2015	8 km	Global	Mean anual NDVI * 10000
	MOD13Q1-coll6	2001-2016	250 m	Global	Mean anual NDVI * 10000
Land cover	ESA CCI	1992-2015	300 m	Global	Land cover classes
Soil taxonomic units	SoilGrids - USDA	Static	250 m	Global	Soil units

Combining Productivity Indicators

The three productivity sub-indicators are then combined as indicated in the tables below. For SDG 15.3.1 reporting, the 3-class indicator is required, but TRENDS.EARTH also produces a 5-class one which takes advantage of the information provided by State to inform the type of degradation occurring in the area.

Aggregating the productivity sub-indicators

Trajectory	State	Performance
Improvement	Improvement	Stable
Improvement	Improvement	Degradation
Improvement	Stable	Stable
Improvement	Stable	Degradation
Improvement	Degradation	Stable
Improvement	Degradation	Degradation
Stable	Improvement	Stable
Stable	Improvement	Degradation
Stable	Stable	Stable
Stable	Stable	Degradation
Stable	Degradation	Stable
Stable	Degradation	Degradation
Degradation	Improvement	Stable
Degradation	Improvement	Degradation
Degradation	Stable	Stable
Degradation	Stable	Degradation
Degradation	Degradation	Stable
Degradation	Degradation	Degradation

3 Classes	5 Classes
Improvement	Improving
Improvement	Improving
Improvement	Improving
Improvement	Improving
Improvement	Improving
Degradation	Stable
Stable	Stable
Stable	Stable
Stable	Stable
Degradation	Stable but stressed
Degradation	Early signs of decline
Degradation	Declining
Degradation	Declining
Degradation	Declining
Degradation	Declining
Degradation	Declining
Degradation	Declining
Degradation	Declining

5.1.2 Land cover

To assess changes in land cover users need land cover maps covering the study area for the baseline and target years. These maps need to be of acceptable accuracy and created in such a way which allows for valid comparisons. TRENDS.EARTH uses ESA CCI land cover maps as the default dataset, but local maps can also be used. The indicator is computed as follows:

1. Reclassify both land cover maps to the 7 land cover classes needed for reporting to the UNCCD (forest, grassland, cropland, wetland, artificial area, bare land and water).
2. Perform a land cover transition analysis to identify which pixels remained in the same land cover class, and which ones changed.
3. Based on your local knowledge of the conditions in the study area and the land degradation processed occurring there, use the table below to identify which transitions correspond to degradation (- sign), improvement (+ sign), or no change in terms of land condition (zero).

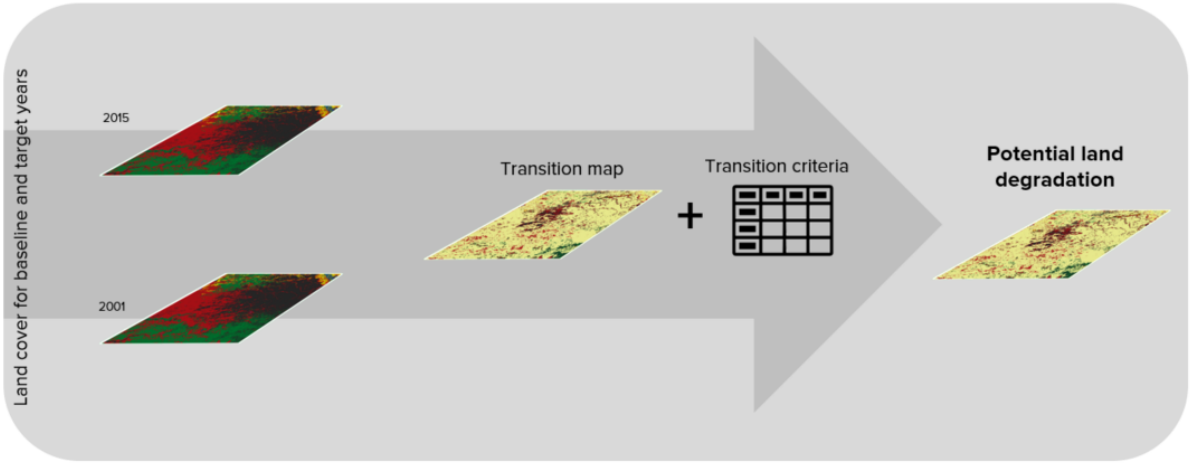
Land cover in baseline year \ Land cover in target year	Forest	Grassland*	Cropland	Wetland	Artificial area	Bare land	Water body
Forest	0	-	-	-	-	-	0
Grassland*	+	0	+	-	-	-	0
Cropland	+	-	0	-	-	-	0
Wetland	-	-	-	0	-	-	0
Artificial area	+	+	+	+	0	+	0
Bare land	+	+	+	+	-	0	0
Water body	0	0	0	0	0	0	0

Legend

Degradation	Stable	Improvement
-	0	+

*The "Grassland" class consists of grassland, shrub, and sparsely vegetated areas (if the default aggregation is used).

1. TRENDS.EARTH will combine the information from the land cover maps and the table of degradation typologies by land cover transition to compute the land cover sub-indicator.



5.1.3 Soil organic carbon

The third sub-indicator for monitoring land degradation as part of the SDG process quantifies changes in soil organic carbon (SOC) over the reporting period. Changes in SOC are particularly difficult to assess for several reasons, some of them being the high spatial variability of soil properties, the time and cost intensiveness of conducting representative soil surveys and the lack of time series data on SOC for most regions of the world. To address some of the limitations, a combined land cover/SOC method is used in TRENDS.EARTH to estimate changes in SOC and identify potentially degraded areas. The indicator is computed as follows:

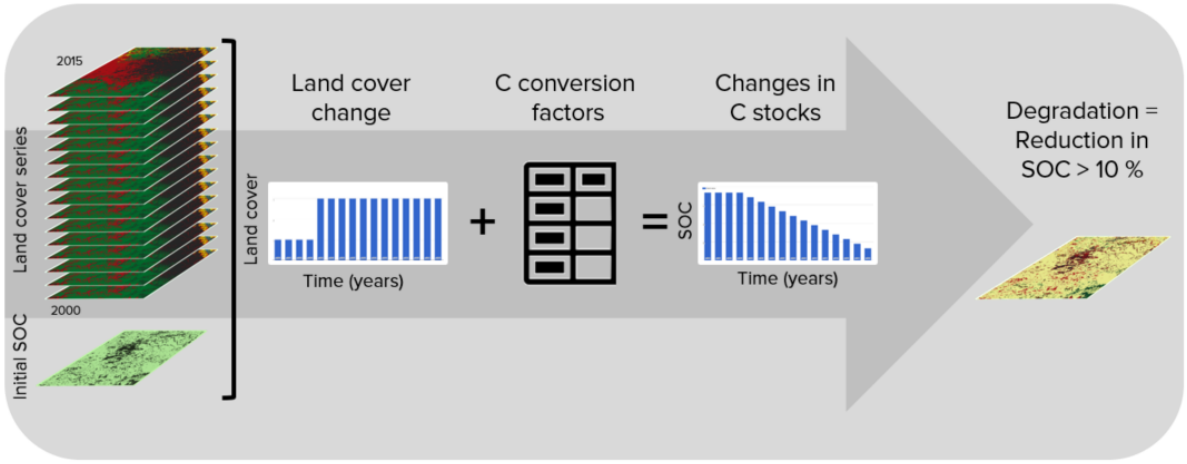
1. Determine the SOC reference values. TRENDS.EARTH uses SoilGrids 250m carbon stocks for the first 30 cm of the soil profile as the reference values for calculation (NOTE: SoilGrids uses information from a variety of data sources and ranging from many years to produce this product, therefore assigning a date for calculations purposes could cause inaccuracies in the stock change calculations).
2. Reclassify the land cover maps to the 7 land cover classes needed for reporting to the UNCCD (forest, grassland, cropland, wetland, artificial area, bare land and water). Ideally annual land cover maps are preferred, but at least land cover maps for the starting and end years are needed.

3. To estimate the changes in C stocks for the reporting period C conversion coefficients for changes in land use, management and inputs are recommended by the IPCC and the UNCCD. However, spatially explicit information on management and C inputs is not available for most regions. As such, only land use conversion coefficient can be applied for estimating changes in C stocks (using land cover as a proxy for land use). The coefficients used were the result of a literature review performed by the UNCCD and are presented in the table below. Those coefficients represent the proportional in C stocks after 20 years of land cover change.

LU coefficients	Forest	Grasslands	Croplands	Wetlands	Artifical areas	Bare lands	Water bodies
Forest	1	1	f	1	0.1	0.1	1
Grasslands	1	1	f	1	0.1	0.1	1
Croplands	1/f	1/f	1	1/0.71	0.1	0.1	1
Wetlands	1	1	0.71	1	0.1	0.1	1
Artifical areas	2	2	2	2	1	1	1
Bare lands	2	2	2	2	1	1	1
Water bodies	1	1	1	1	1	1	1

Changes in SOC are better studied for land cover transitions involving agriculture, and for that reason there is a different set of coefficients for each of the main global climatic regions: Temperate Dry (f = 0.80), Temperate Moist (f = 0.69), Tropical Dry (f = 0.58), Tropical Moist (f = 0.48), and Tropical Montane (f = 0.64).

4. Compute relative different in SOC between the baseline and the target period, areas which experienced a loss in SOC of 10% of more during the reporting period will be considered potentially degraded, and areas experiencing a gain of 10% or more as potentially improved.



5.2 Combining indicators

The integration of the three SDG 15.3.1 sub-indicators is done following the one-out all-out rule, this means that if an area was identified as potentially degraded by any of the sub-indicators, then that area will be considered potentially degraded for reporting purposes.

Aggregating SDG 15.3.1 sub-indicators

Productivity	Land Cover	SOC	SDG 15.3.1
Improvement	Improvement	Improvement	Improvement
Improvement	Improvement	Stable	Improvement
Improvement	Improvement	Degradation	Degradation
Improvement	Stable	Improvement	Improvement
Improvement	Stable	Stable	Improvement
Improvement	Stable	Degradation	Degradation
Improvement	Degradation	Improvement	Degradation
Improvement	Degradation	Stable	Degradation
Improvement	Degradation	Degradation	Degradation
Stable	Improvement	Improvement	Improvement
Stable	Improvement	Stable	Improvement
Stable	Improvement	Degradation	Degradation
Stable	Stable	Improvement	Improvement
Stable	Stable	Stable	Stable
Stable	Stable	Degradation	Degradation
Stable	Degradation	Improvement	Degradation
Stable	Degradation	Stable	Degradation
Stable	Degradation	Degradation	Degradation
Degradation	Improvement	Improvement	Degradation
Degradation	Improvement	Stable	Degradation
Degradation	Improvement	Degradation	Degradation
Degradation	Stable	Improvement	Degradation
Degradation	Stable	Stable	Degradation
Degradation	Stable	Degradation	Degradation
Degradation	Degradation	Improvement	Degradation
Degradation	Degradation	Stable	Degradation
Degradation	Degradation	Degradation	Degradation

CHAPTER 6

Before installing the toolbox

Before installing the toolbox, QGIS version 2.18.15 or higher needs to be installed on the computer (Note: QGIS version 3.0.0 is not currently supported). QGIS can be downloaded from: http://www.qgis.org/en/site/forusers/download.html. Once the installer is downloaded from the website, it needs to be run (double click on it). Select the options using the Default settings.

You have the option of installing a 32-bit or 64-bit version of QGIS. To know which version to install, check which type of operating system you have:

Windows 7 or Windows Vista

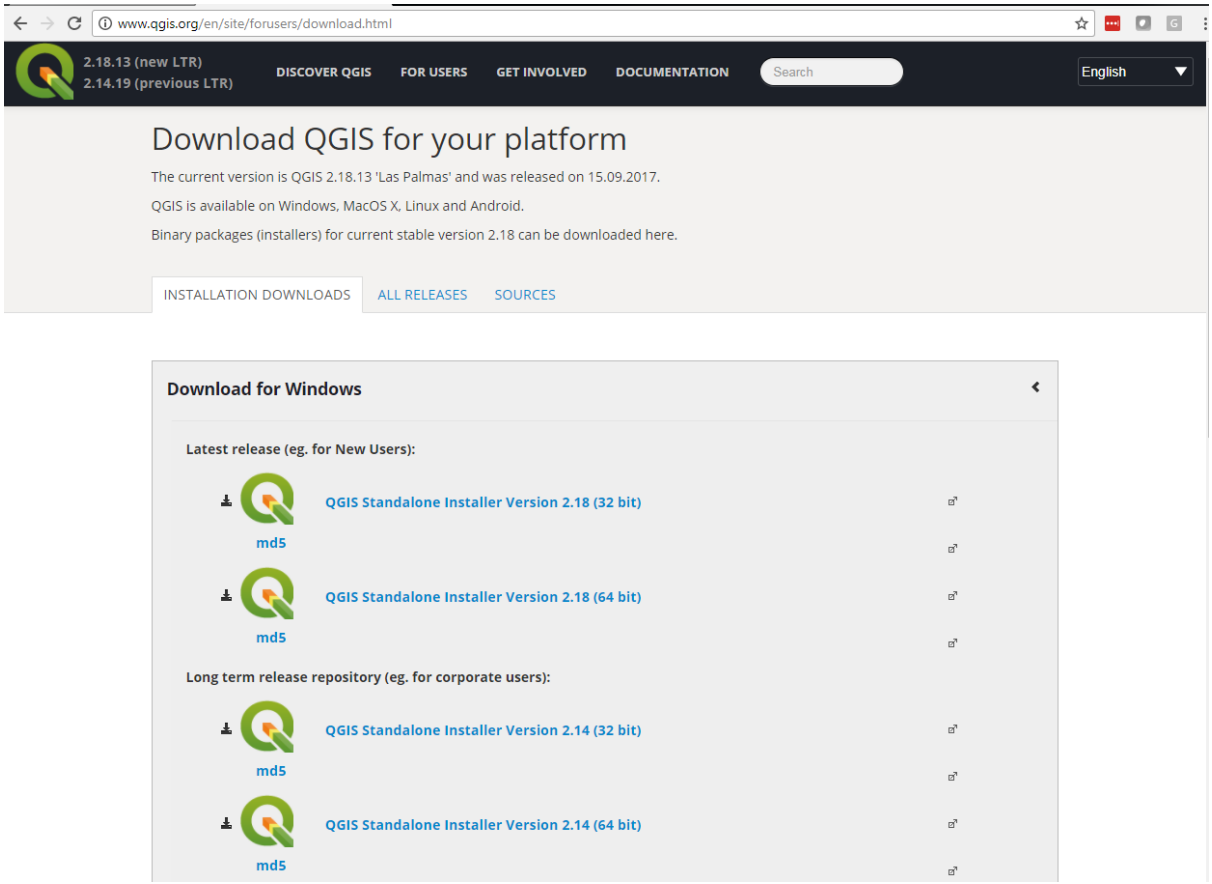
1. Open System by clicking the Start button , right-clicking Computer, and then clicking Properties.
2. Under System, you can view the system type.

Windows 8 or Windows 10

1. From the Start screen, type This PC.
2. Right Click (or tap and hold) This PC, and click Properties.

Mac

1. Click the Apple icon in the top left and select About this Mac.


www.qgis.org/en/site/forusers/download.html
2.18.13 (new LTR)
2.14.19 (previous LTR)
DISCOVER QGIS
FOR USERS
GET INVOLVED
DOCUMENTATION
Search
English
Download QGIS for your platform
The current version is QGIS 2.18.13 'Las Palmas' and was released on 15.09.2017.
QGIS is available on Windows, MacOS X, Linux and Android.
Binary packages (installers) for current stable version 2.18 can be downloaded here.
INSTALLATION DOWNLOADS
ALL RELEASES
SOURCES
Download for Windows
Latest release (eg. for New Users):
QGIS Standalone Installer Version 2.18 (32 bit)
md5
QGIS Standalone Installer Version 2.18 (64 bit)
md5
Long term release repository (eg. for corporate users):
QGIS Standalone Installer Version 2.14 (32 bit)
md5
QGIS Standalone Installer Version 2.14 (64 bit)
md5

CHAPTER 7

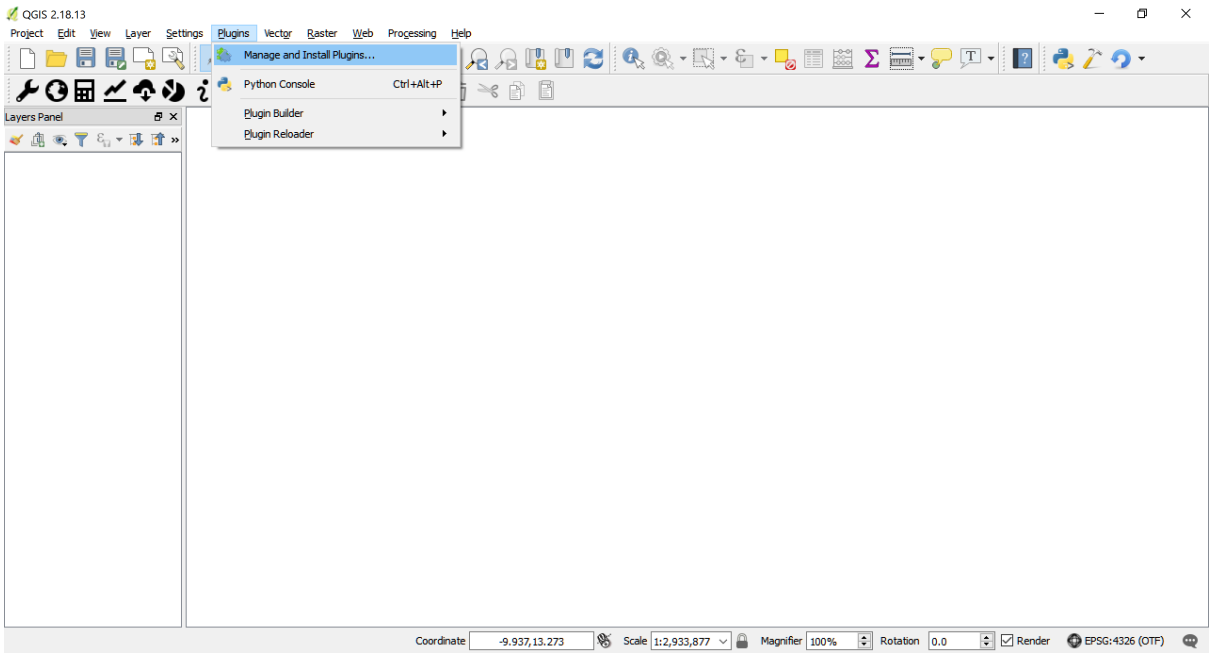
Installing the toolbox

There are different ways to install TRENDS.EARTH, depending on whether you want to install the stable version (recommended) or the development version.

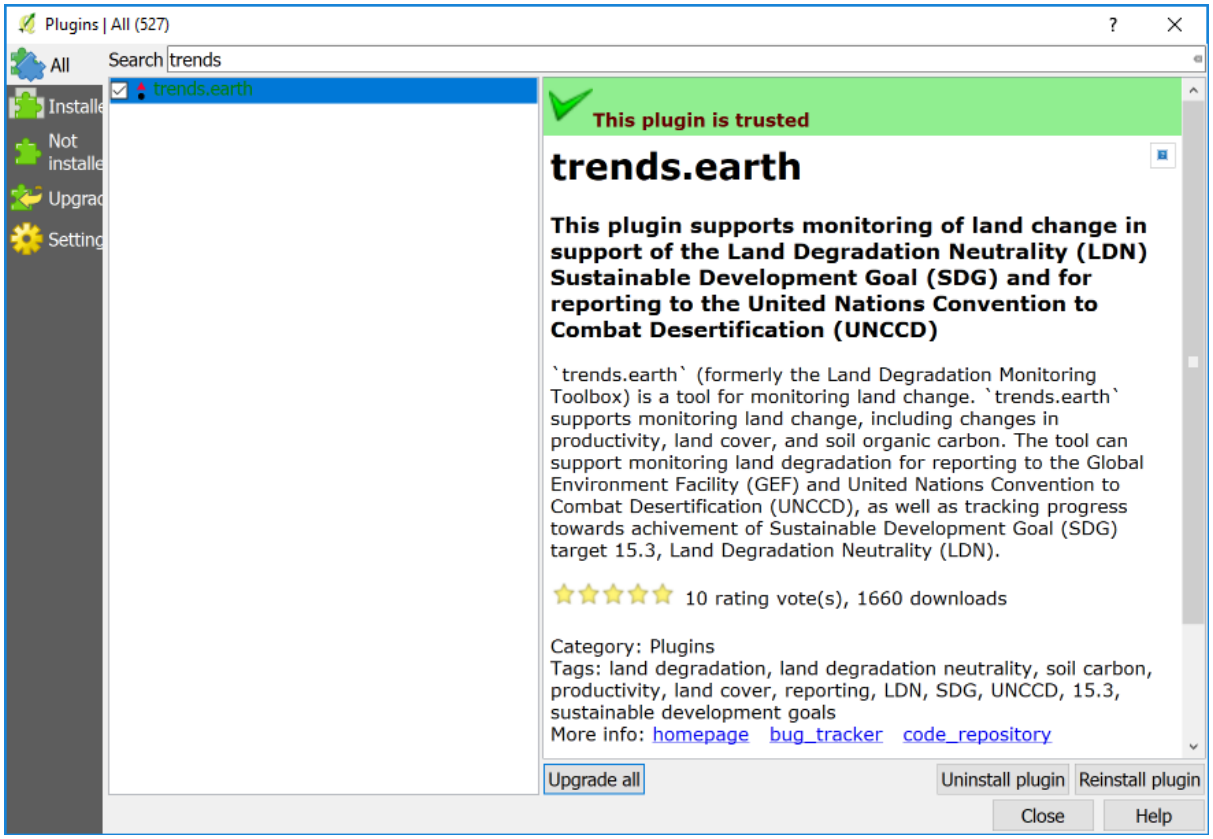
> Warning: QGIS 3.0 is not currently supported by TRENDS.EARTH, so the plugin will not appear in the plugin window f you are using QGIS 3.0. To use TRENDS.EARTH you must install QGIS version 2.18. See Before installing the toolbox for more information.

7.1 Installing the stable version (recommended)

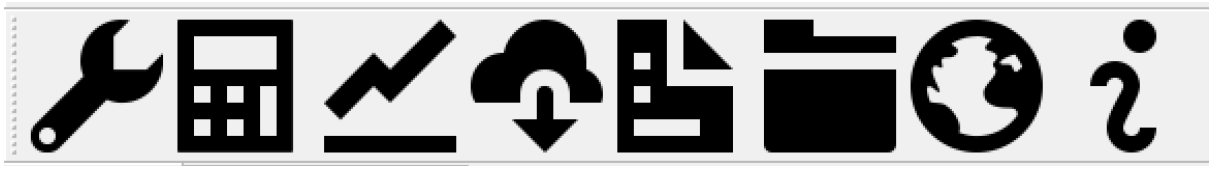
The preferred way to install the TRENDS.EARTH is through QGIS. To install from within QGIS, first launch QGIS, and then go to Plugins in the menu bar at the top of the program and select Manage and install plugins.



Then search for a plugin called trends.earth and select Install plugin at the bottom right of the screen.



If your plugin has been installed properly, there will be a menu bar in the top left of your browser that looks like this:



7.2 Installing the development version (advanced users)

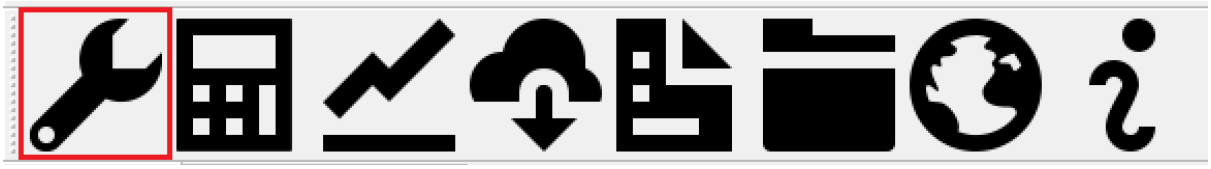
There are two ways to install the development version of the plugin. For more details, see the README for TRENDS.EARTH.

Part III

Documentation

CHAPTER 8

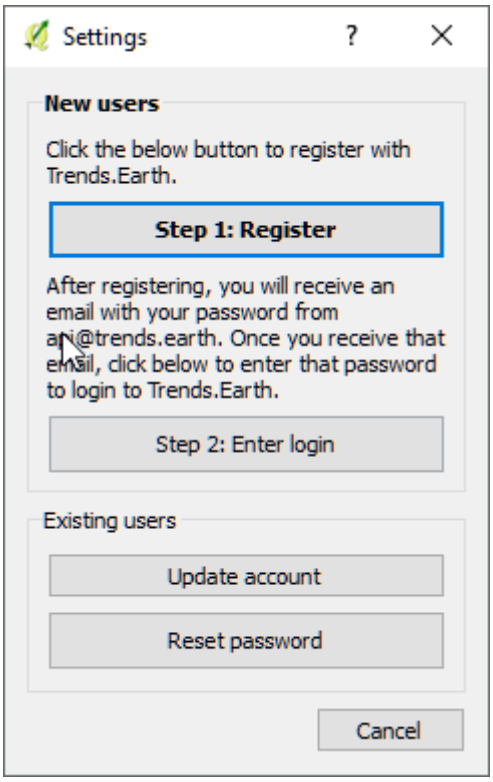
Registration and settings



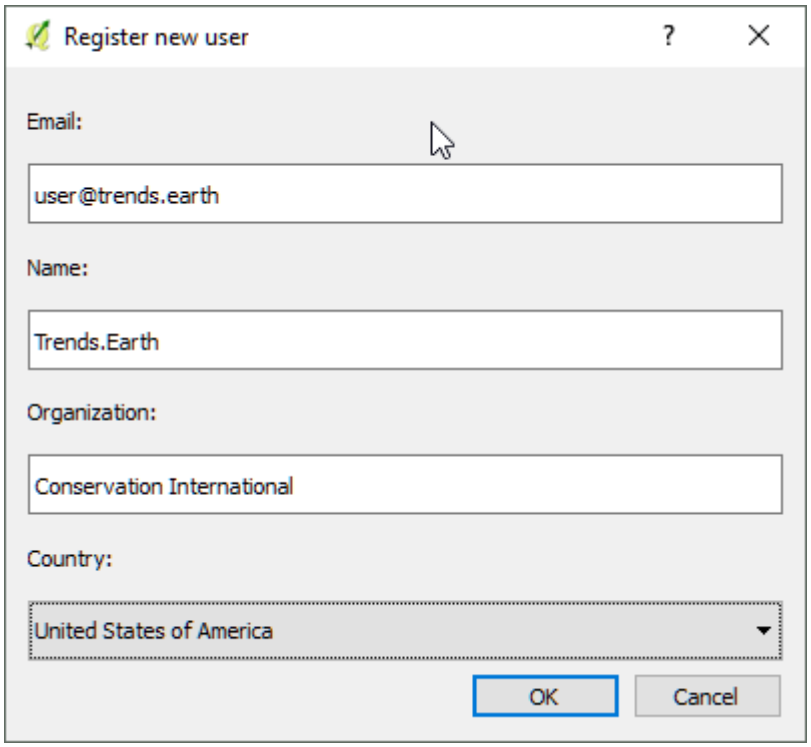
8.1 Registration

The toolbox is free to use, but you must register an email address prior to using any of the cloud-based functions.

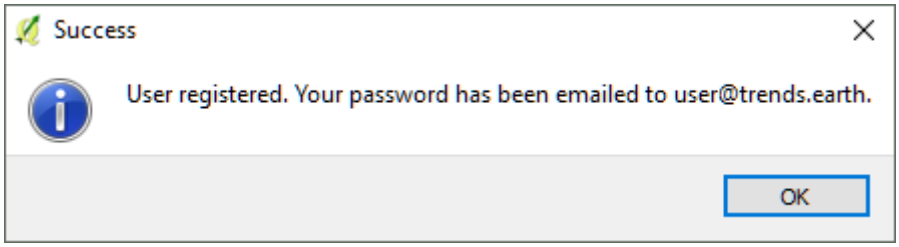
To register your email address and obtain a free account, select the wrench icon (). This will open up the “Settings” dialog box:



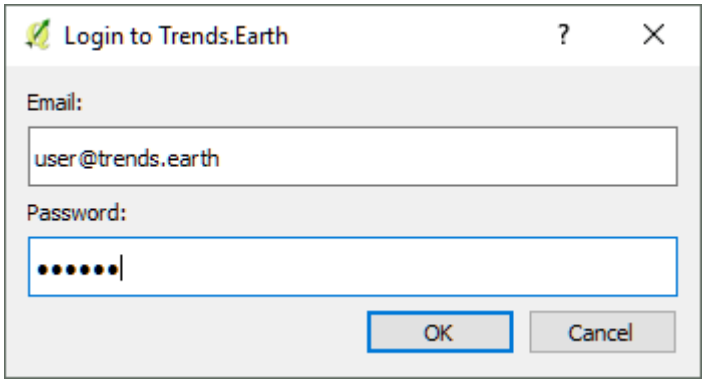
To Register, click the "Step 1: Register" button. Enter your email, name, organization and country of residence and select "Ok":



You will see a meesage indicating your user has been registered:



After registering, you will receive an email from api@trends.earth with your password. Once you receive this email, click on "Step 2: Enter login". This will bring up a dialog asking for your email and password. Enter the password you received from api@trends.earth and click "Ok":

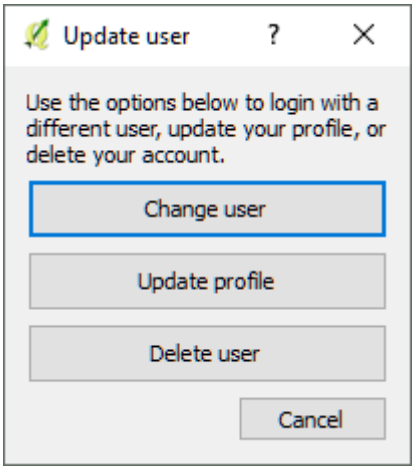


You will see a message indicating you have successfully been logged in:



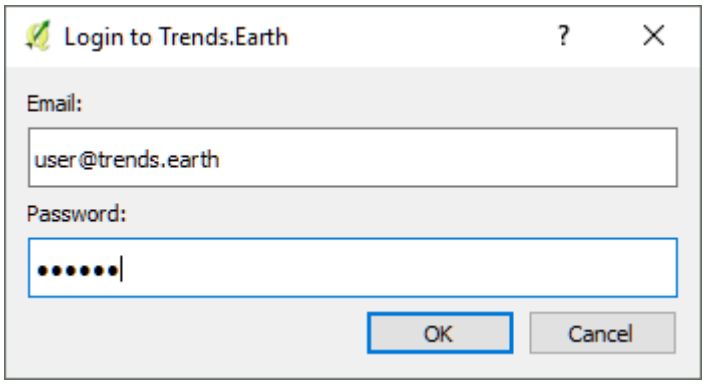
8.2 Updating your user

If you already are registered for TRENDS.EARTH but want to change your login information; update your name, organization, or country; or delete your user, click on "Update user" from the "Settings" dialog.

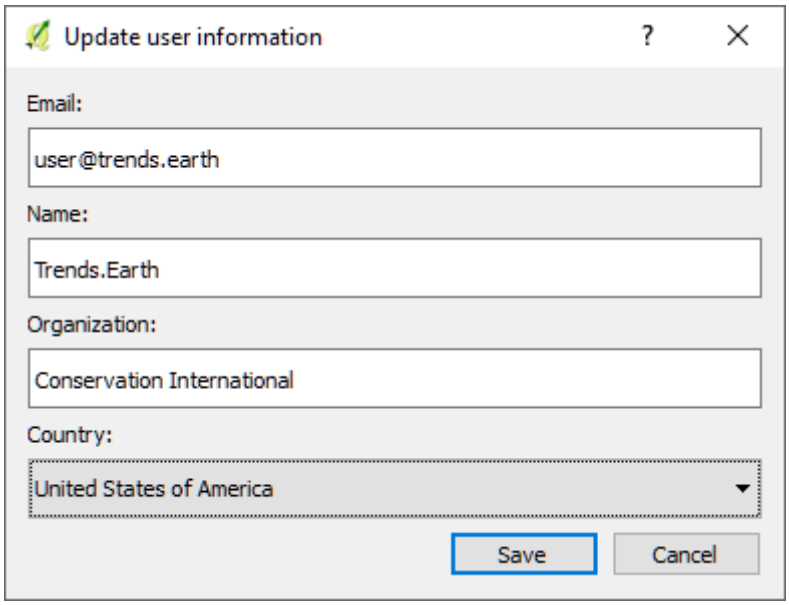


If you want to change your username, click on "Change user". Note that this function is only useful if you already have another existing TRENDS.EARTH account you want to switch to. To register a new

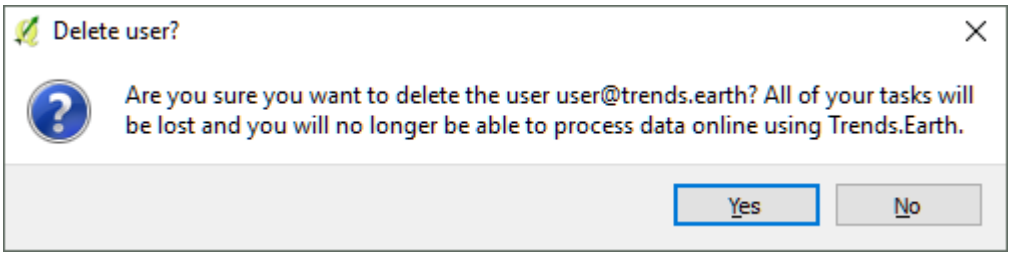
user, see Registration. To change your user, enter the email and password you wish to change to and click "Ok":



If you want to update your profile, click on "Update profile". Update your information in the box that appears and click "Save":



To delete your user, click "Delete user". A warning message will appear. Click "Ok" if you are sure you want to delete your user:

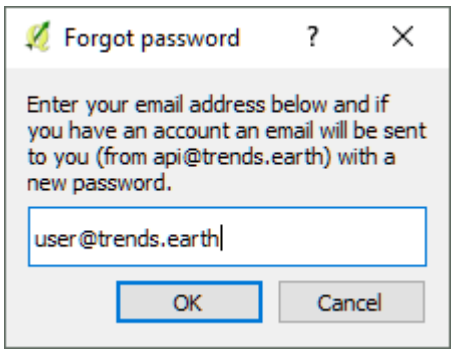


8.3 Forgot password

If you forget your password, click on "Reset password" from the settings dialog box.

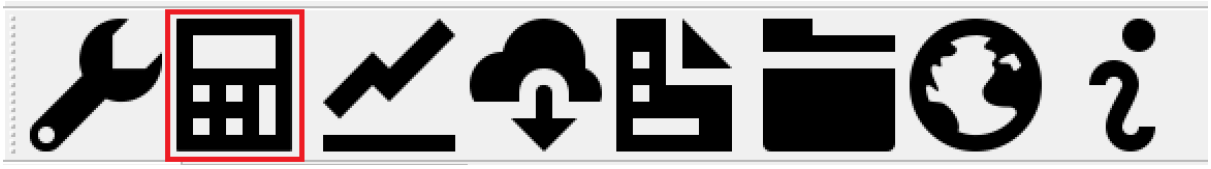
A password will be sent to your email. Please check your Junk folder if you cannot find it within your inbox. The email will come from api@trends.earth.

Once you receive your new password, return to the "Settings" screen and use "Step 2: Enter login" to enter your new pasword.


Forgot password
Enter your email address below and if you have an account an email will be sent to you (from api@trends.earth) with a new password.
user@trends.earth
OK
Cancel

CHAPTER 9

Calculate indicators

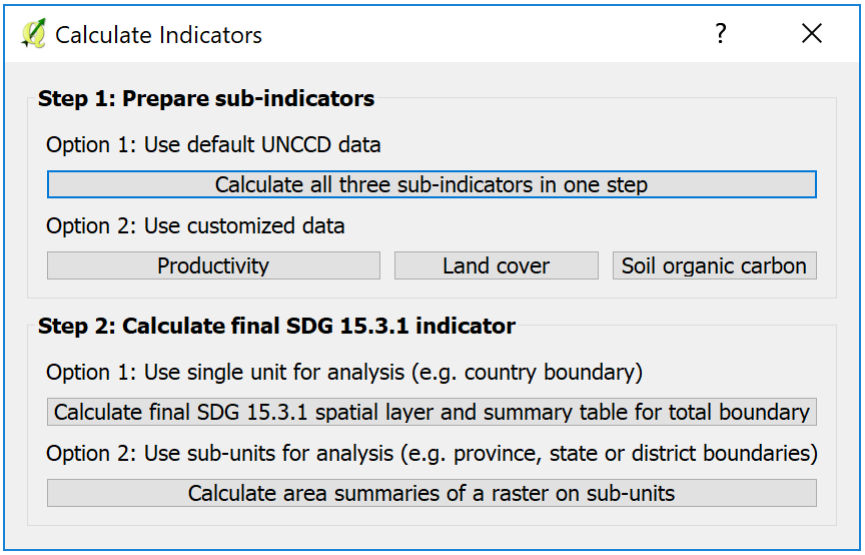


Sustainable Development Goal 15.3 intends to combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world by 2030. In order to assess the progress to this goal, the agreed-upon indicator for SDG 15.3 (proportion of land area degraded) is a combination of three sub-indicators: change in land productivity, change in land cover and change in soil organic carbon.

Contents

- Calculate indicators
  - Calculate indicators with simplified tool
  - Calculate productivity
    - Productivity Trajectory
    - Productivity Performance
    - Productivity State
  - Calculate land cover
  - Calculate soil carbon
  - Compute SDG Indicator 15.3.1

To select the methods and datasets to calculate these indicators, indicators click on the calculator icon (). This will open up the “Calculate Indicators” dialog box.



There are several options for calculating the SDG 15.3.1 Indicator. TRENDS.EARTH supports calculating the indicator using the same process as was used by the UNCCD for the default data provided to countries for the 2018 reporting process. The tool also supports customizing this data, or even replacing individual datasets with national-level or other global datasets.

- To calculate all three SDG 15.3.1 indicators in one step, using default settings for most of the indicators, click "Calculate all three indicators in one step".
- To calculate one of the three SDG 15.3.1 indicators, using customized settings, or national-level data, click "Productivity", "Land cover", or "Soil organic carbon".
- To calculate a summary table showing statistics on each of the three indicators, click "Calculate final SDG 15.3.1 indicator and summary table". Note that you must first compute the indicators using one of the above options.
- To calculate a summary table showing statistics on each of the three indicators for multiple subdivisions, click "Calculate area summaries of a raster on sub-units". Note that you must first compute the indicators using one of the above options.

There are three different indicators that are combined to create the SDG 15.3.1 indicator

- Productivity: measures the trajectory, performance and state of primary productivity
- Land cover: calculates land cover change relative to a baseline period, enter a transition matrix indicating which transitions indicate degradation, stability or improvement.
- Soil carbon: compute changes in soil organic carbon as a consequence of changes in land cover.

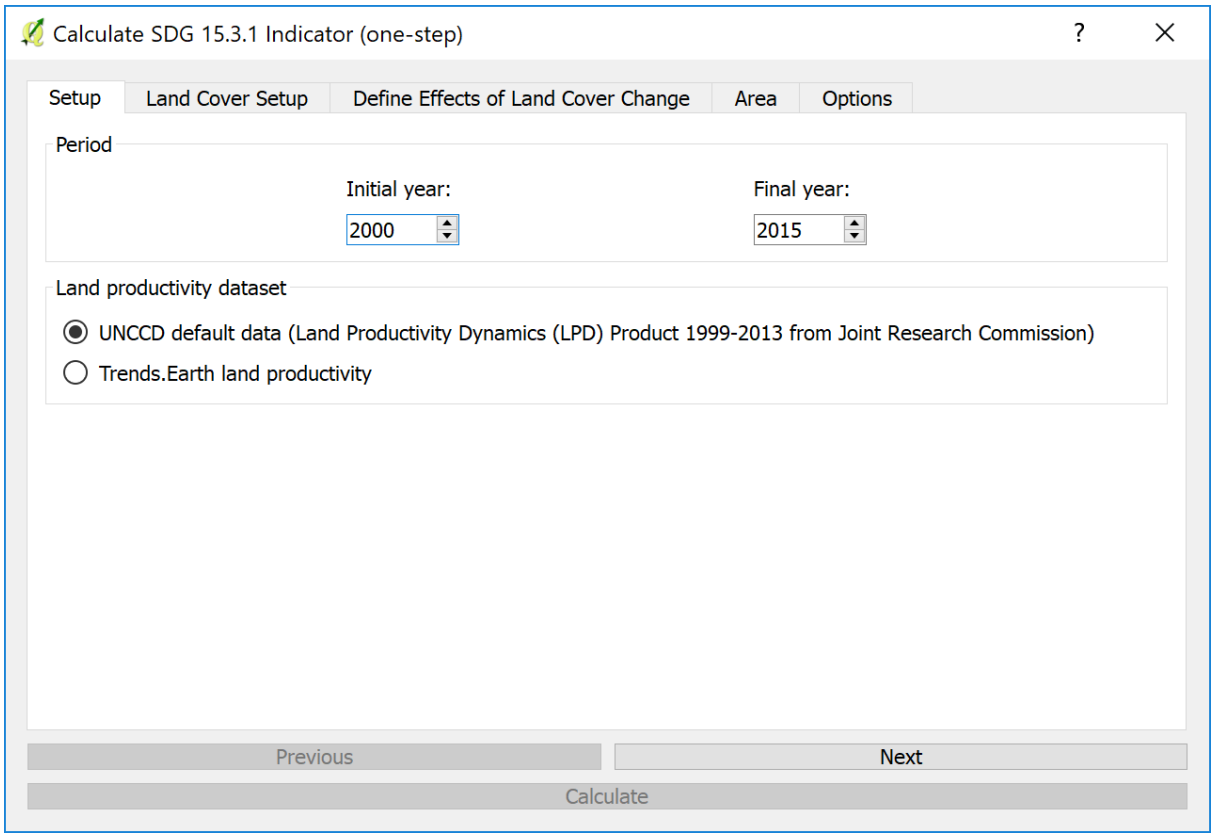
Note: Refer to the SDG Indicator 15.3.1 section of this manual for a detailed explanation of how each of these sub-indicators is computed in TRENDS.EARTH

There are two ways to calculate the indicators: 1) using a simplified tool that will calculate all three indicators at once, but with limited options for customization, or 2) using individual tools for each indicator that offer complete control over how they are calculated.

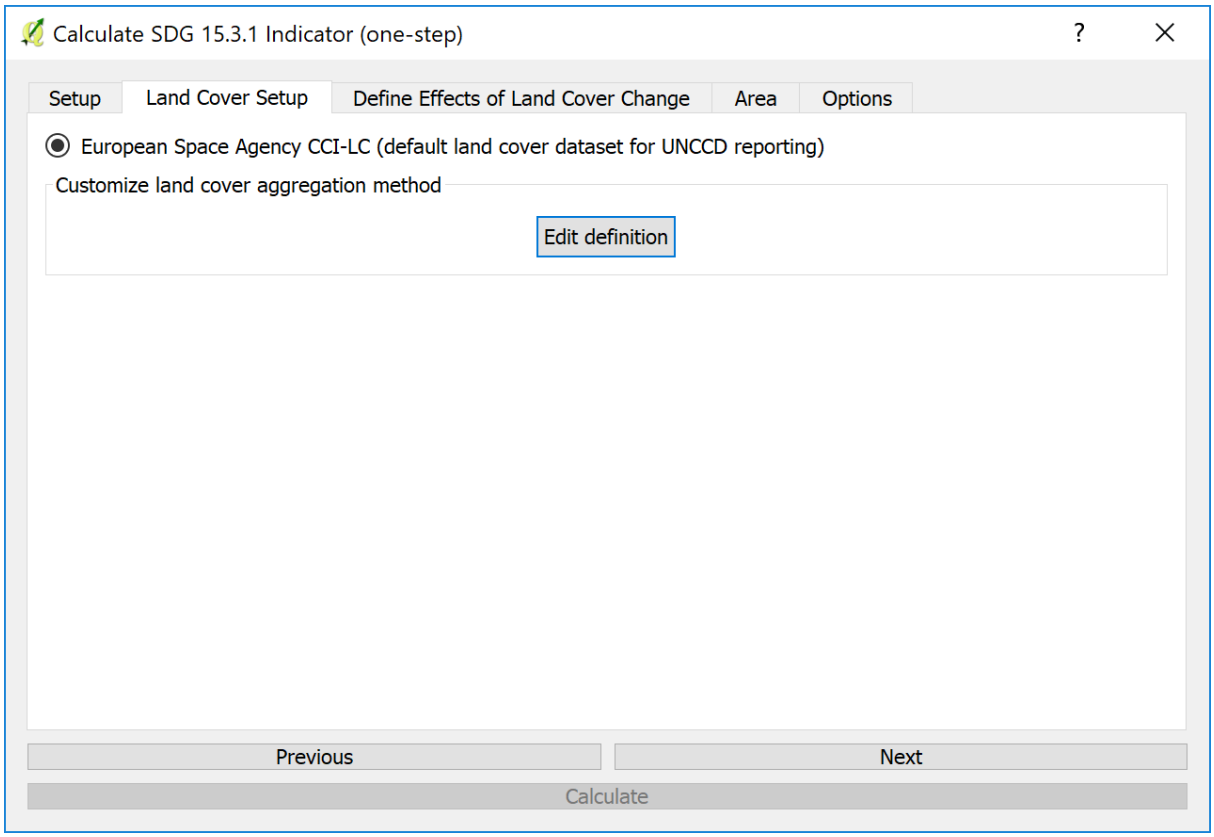
9.1 Calculate indicators with simplified tool

This tool allows users to calculate all three sub-indicators in one step. Select the "Calculate all three sub-indicators in one step" button.

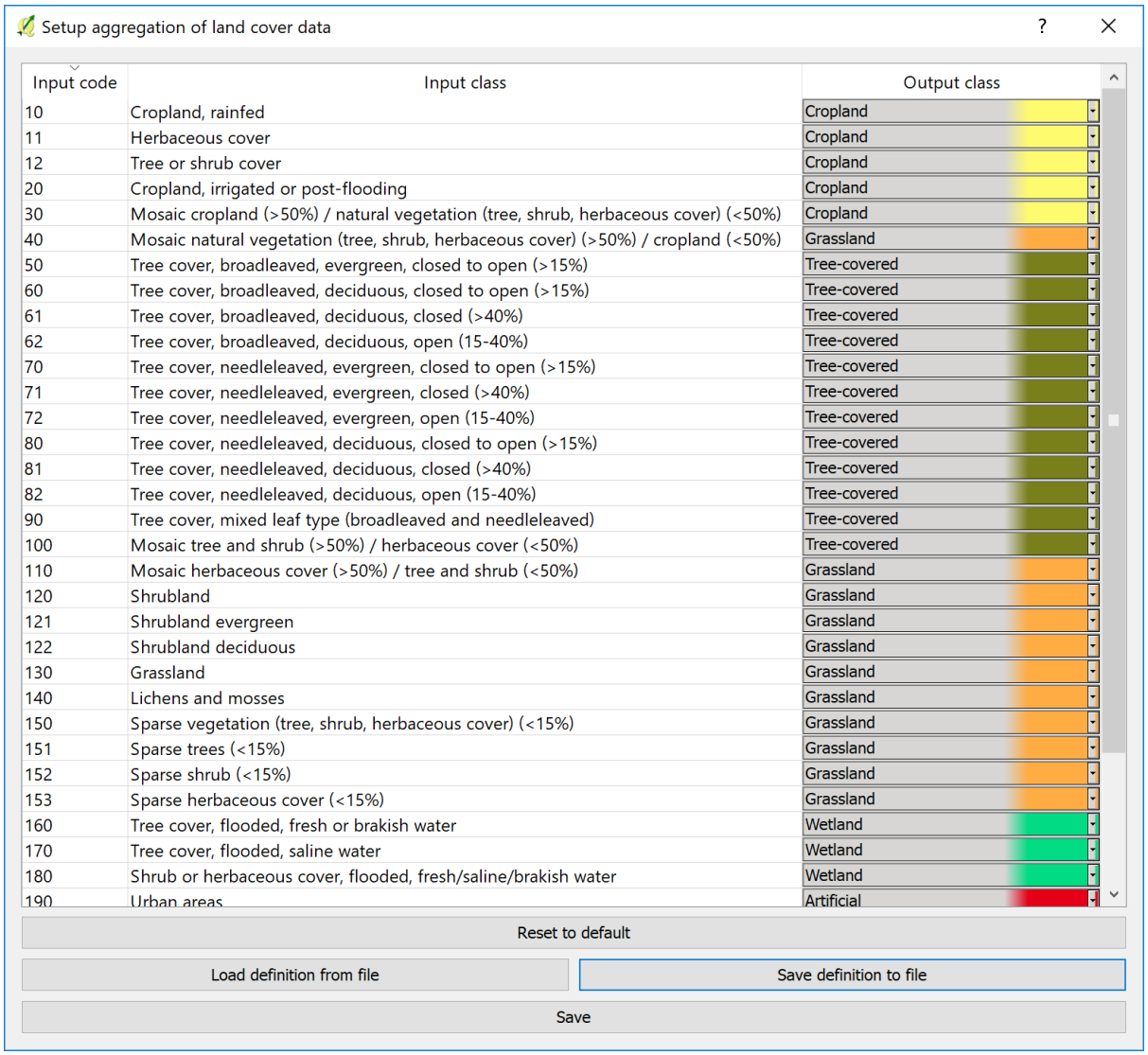
1. Select the parameters for Setup. The Period is the Initial and Final year for the analysis and select one of the two Land Productivity datasets. Select Next.



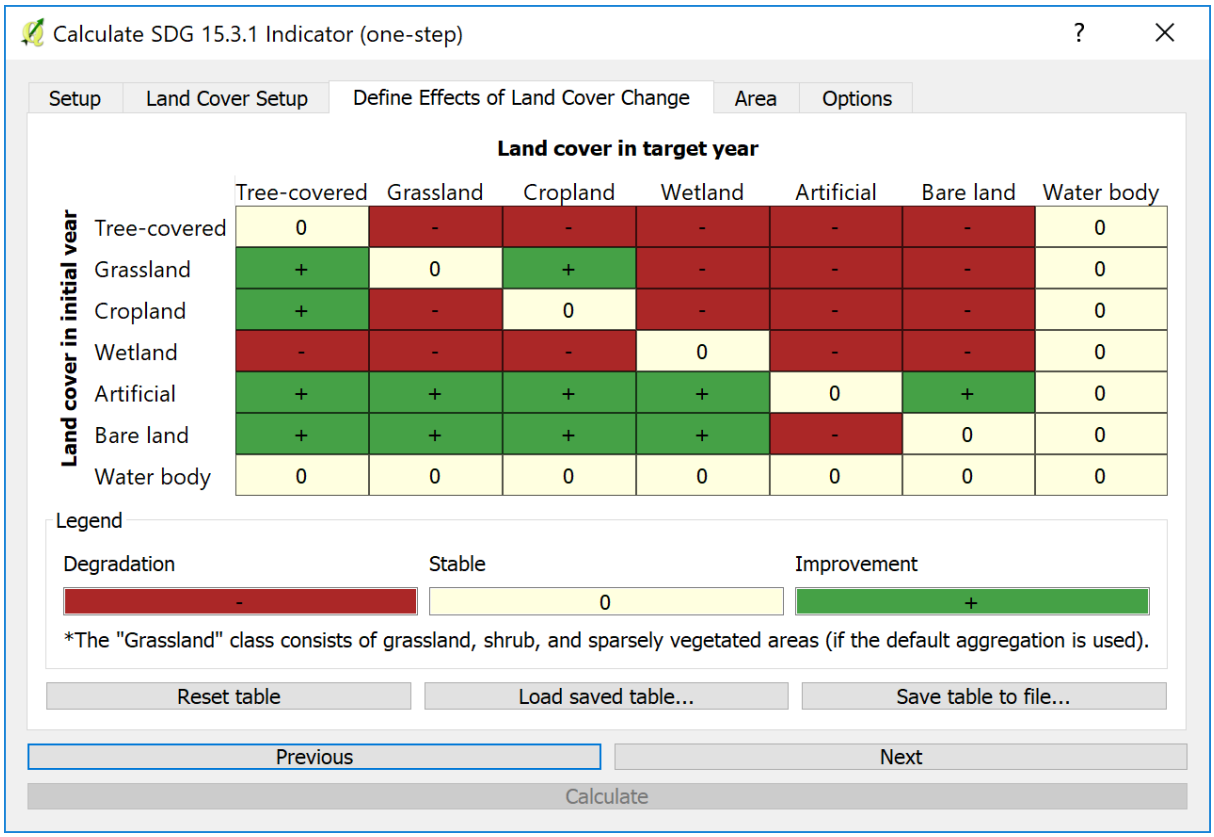
2. Select the Land Cover dataset. The first option is the default ESA dataset.



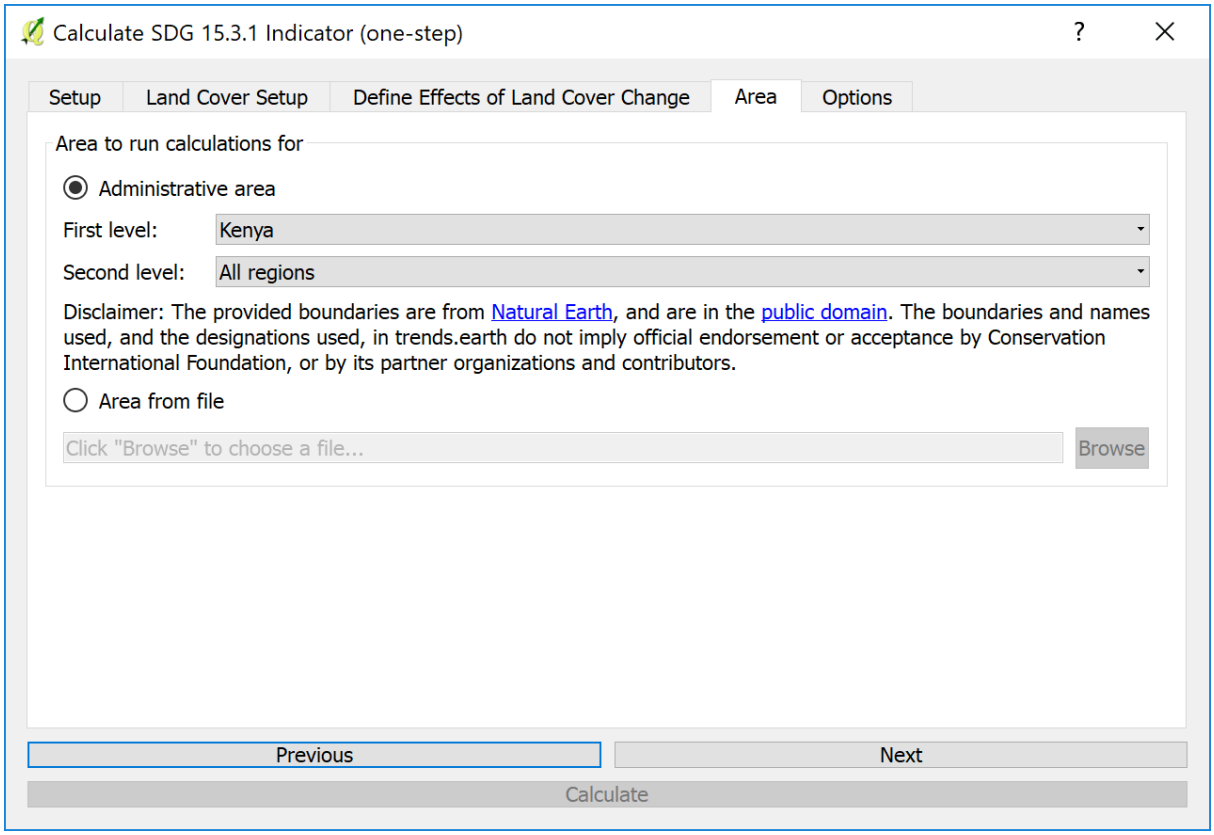
3. Select Edit definition to change the aggregation from the ESA Land Cover dataset into 7 classes.



The second option allows users to upload a custom land cover dataset. This requires two datasets to compare change over time. Select Next.



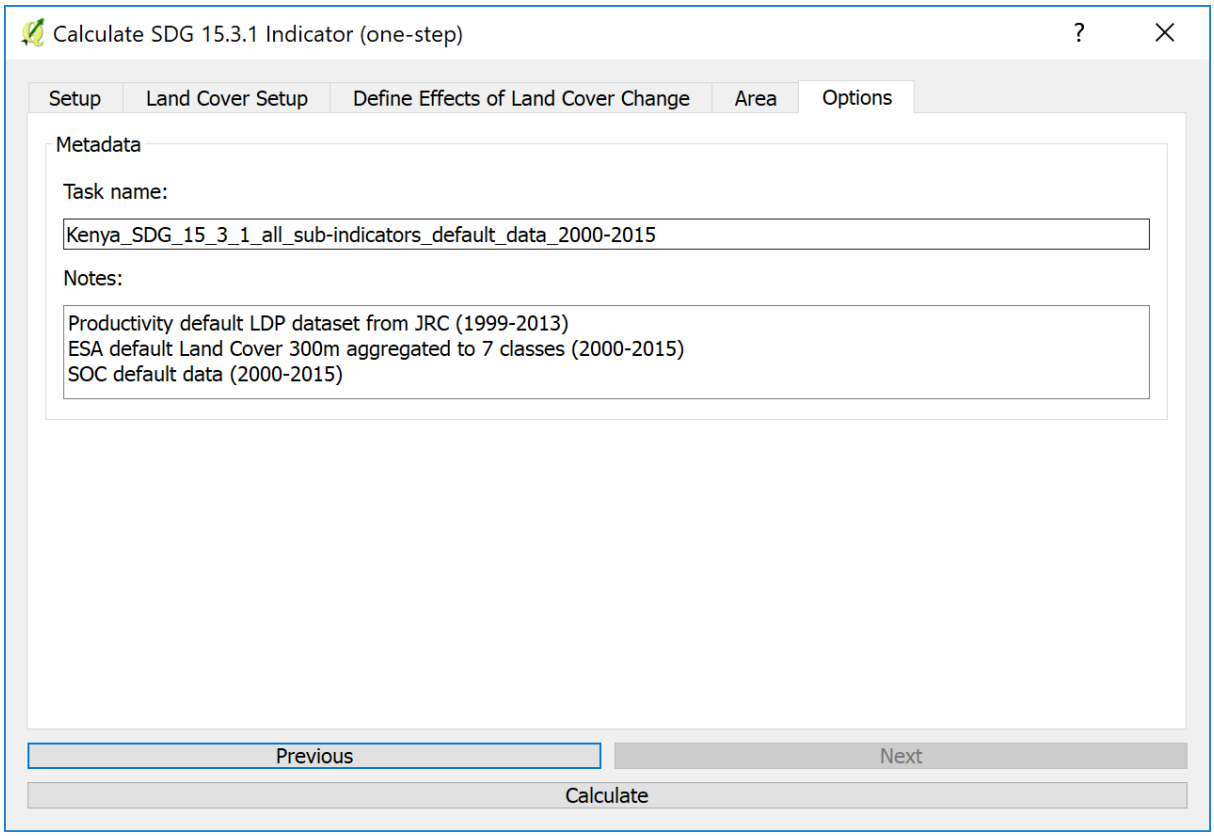
4. The user can now define the effects of land cover change and how it is classified as degrading or improving.



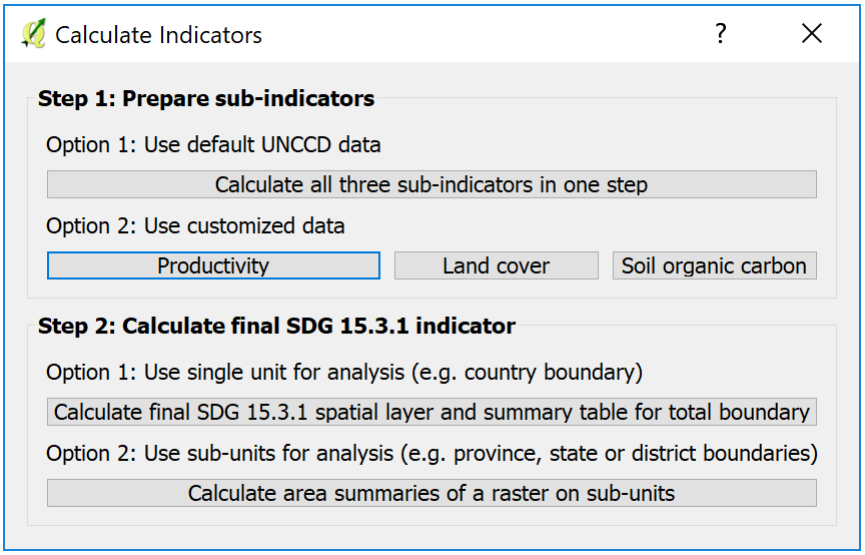
5. Select an area to run the analysis or upload a shapefile boundary

Note: The provided boundaries are from Natural Earth, and are in the public domain. The boundaries and names used, and the designations used, in Trends.Earth do not imply official endorsement or acceptance by Conservation International Foundation, or by its partner organizations and contributors.

If using Trends.Earth for official purposes, it is recommended that users choose an official boundary provided by the designated office of their country.



6. Name the task and make notes for future reference
7. Click on "Calculate" to submit your task to Google Earth Engine



9.2 Calculate productivity

Note: Refer to the Productivity background information in this manual for a detailed explanation of how productivity is computed.

Productivity measures the trajectory, performance and state of primary productivity using either 8km AVHRR or 250m MODIS datasets. The user can select one or multiple indicators to calculate, the NDVI dataset, name the tasks and enter in explanatory notes for their intended reporting area.

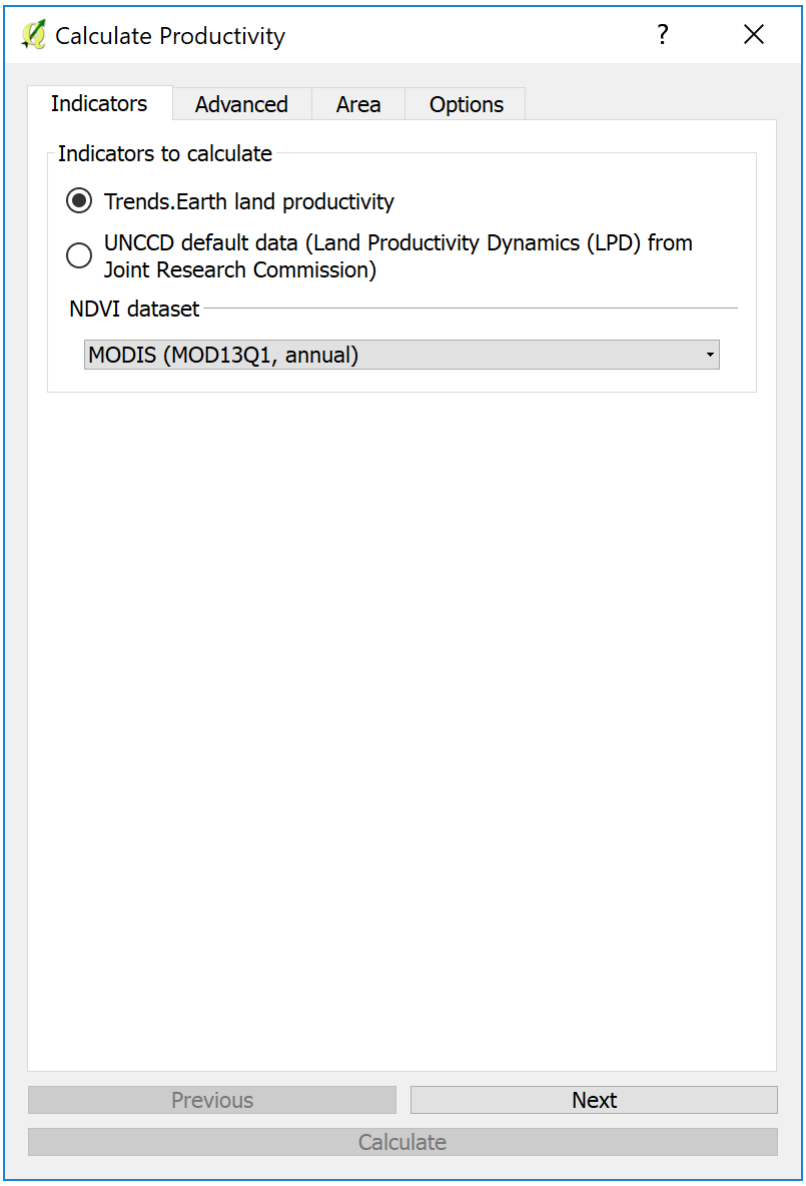
9.2.1 Productivity Trajectory

Trajectory assesses the rate of change of productivity over time. To calculate trajectory:

Note: Refer to the Productivity Trajectory section in this manual for a detailed explanation of this indicator is computed.

1. Select an indicator to calculate
2. Select NDVI dataset to use and select Next

Note: The valid date range is set by the NDVI dataset selected within the first tab: AVHRR dates compare 1982-2015 and MODIS 2001-2016.



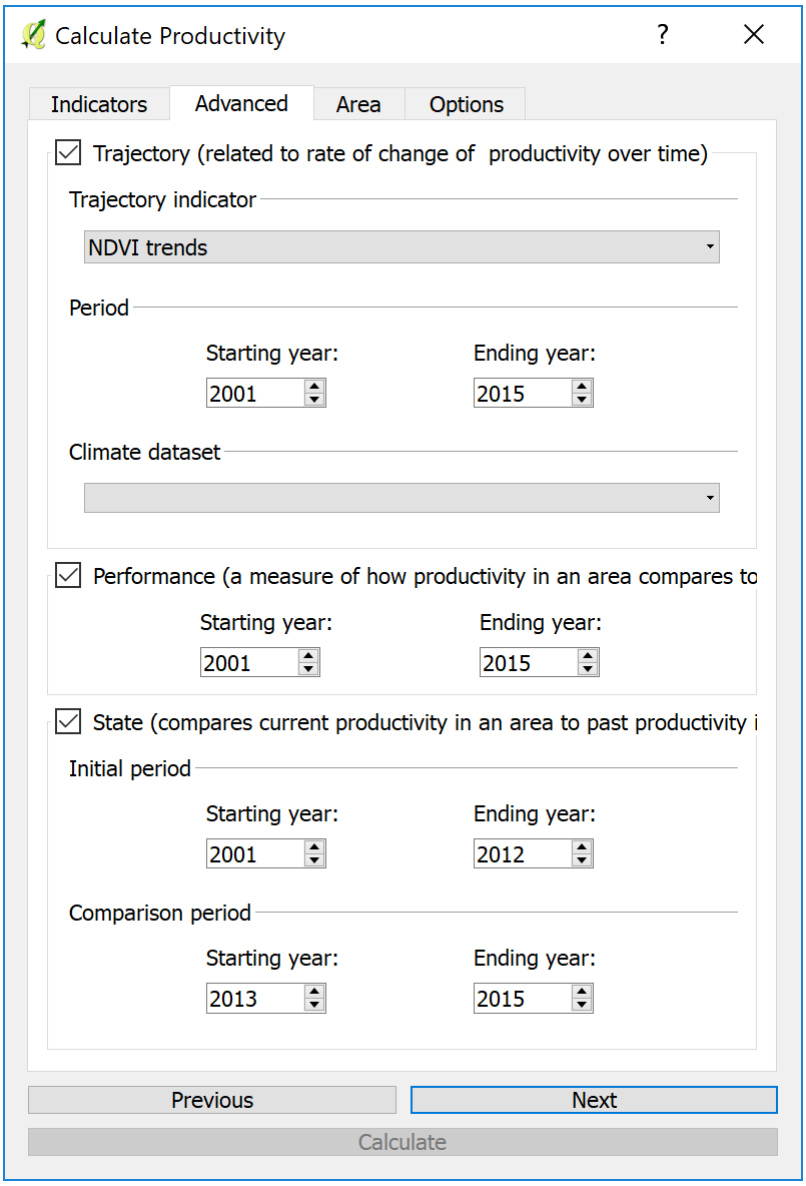
3. In the tab "Advanced", select the method to be used to compute the productivity trajectory analysis. The options are:

Note: Refer to the Correcting for the effects of climate information in this manual for a more detailed explanation of each of these calculations.

- NDVI trend: This dataset shows the trend in annually integrated NDVI time series (2001-2015) using MODIS (250m) dataset (MOD13Q1) or AVHRR (8km; GIMMS3g.v1). The normalized difference vegetation index (NDVI) is the ratio of the difference between near-infrared band (NIR) and the red band (RED) and the sum of these two bands (Rouse et al., 1974; Deering 1978) and reviewed in Tucker (1979).
- RUE: is defined as the ratio between net primary production (NPP), in this case annual integrals of NDVI, and rainfall. It has been increasingly used to analyze the variability of vegetation production in arid and semi-arid biomes, where rainfall is a major limiting factor for plant growth
- RESTREND: this method attempts to adjust the NDVI signals from the effect of particular climatic drivers, such as rainfall or soil moisture, using a pixel-by-pixel linear regression on the NDVI time series and the climate signal. The linear model and the climatic data is used then to predict NDVI, and to compute the residuals between the observed and climate-predicted NDVI annual integrals. The NDVI residual trend is finally plotted to spatially represent overall trends in primary

productivity independent of climate.

- WUE: is defined as the ratio between net primary production (NPP), in this case annual integrals of NDVI, and evapotranspiration.



9.2.2 Productivity Performance

Performance is a comparison of how productivity in an area compares to productivity in similar areas at the same point in time. To calculate performance:

1. Select the start and end year of the period of analysis for comparison.

Note: Refer to the Productivity Performance section in this manual for a detailed explanation of this indicator is computed.

9.2.3 Productivity State

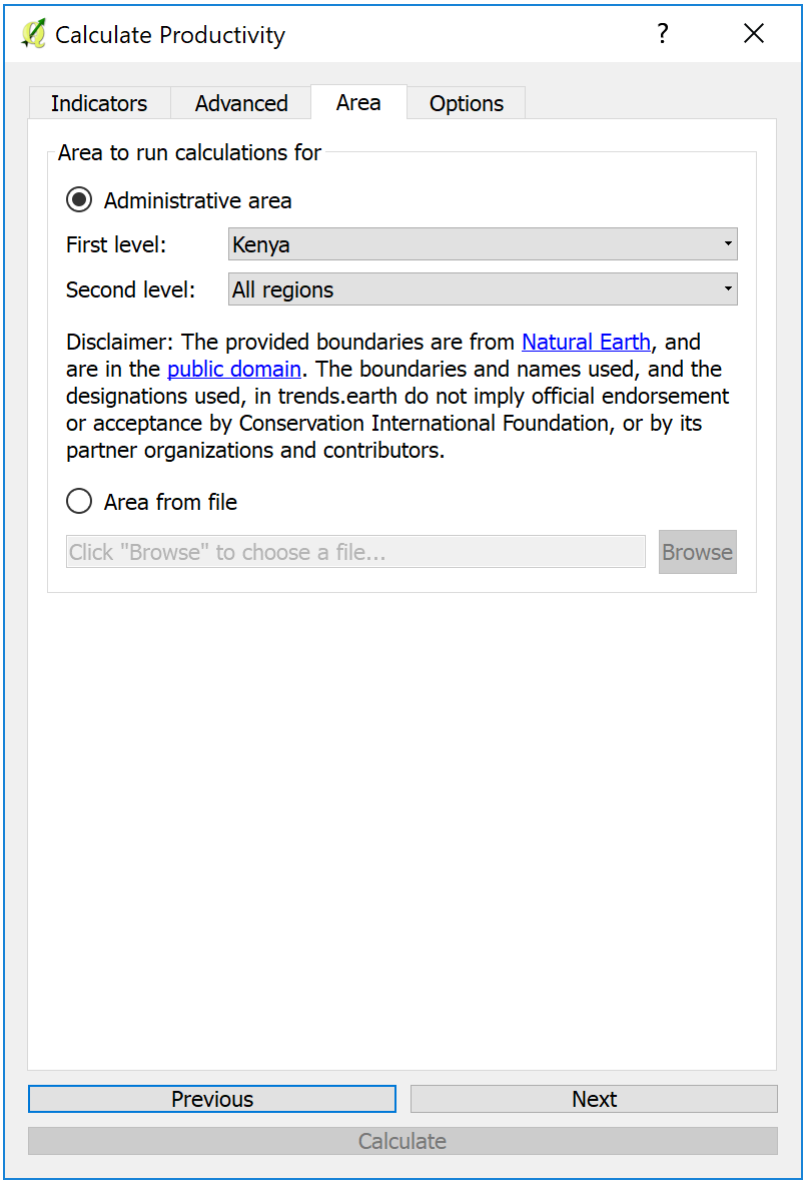
State performs a comparison of how current productivity in an area compares to past productivity. To calculate state:

1. Define the baseline and comparison periods for the computation of the State sub-indicator.

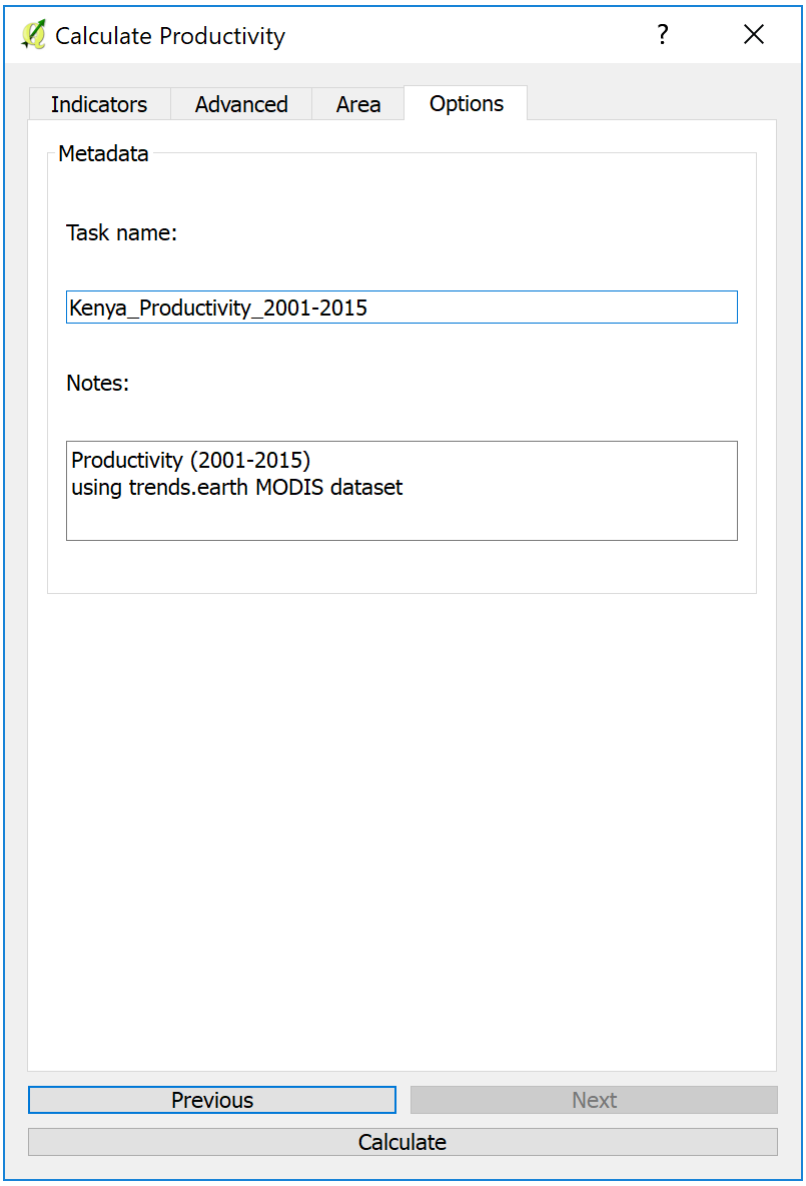
Note: Refer to the Productivity State section in this manual for a detailed explanation of this indicator is computed.

The next step is to define the study area on which to perform the analysis. The tool allows selecting the area of interest in one of two ways:

1. Selects first (i.e. country) and/or second (i.e. province or state) administrative boundary from a drop-down menu.
2. The user can provide a shapefile, KML, or geojson defining an area of interest. Once this is done, Select Next.

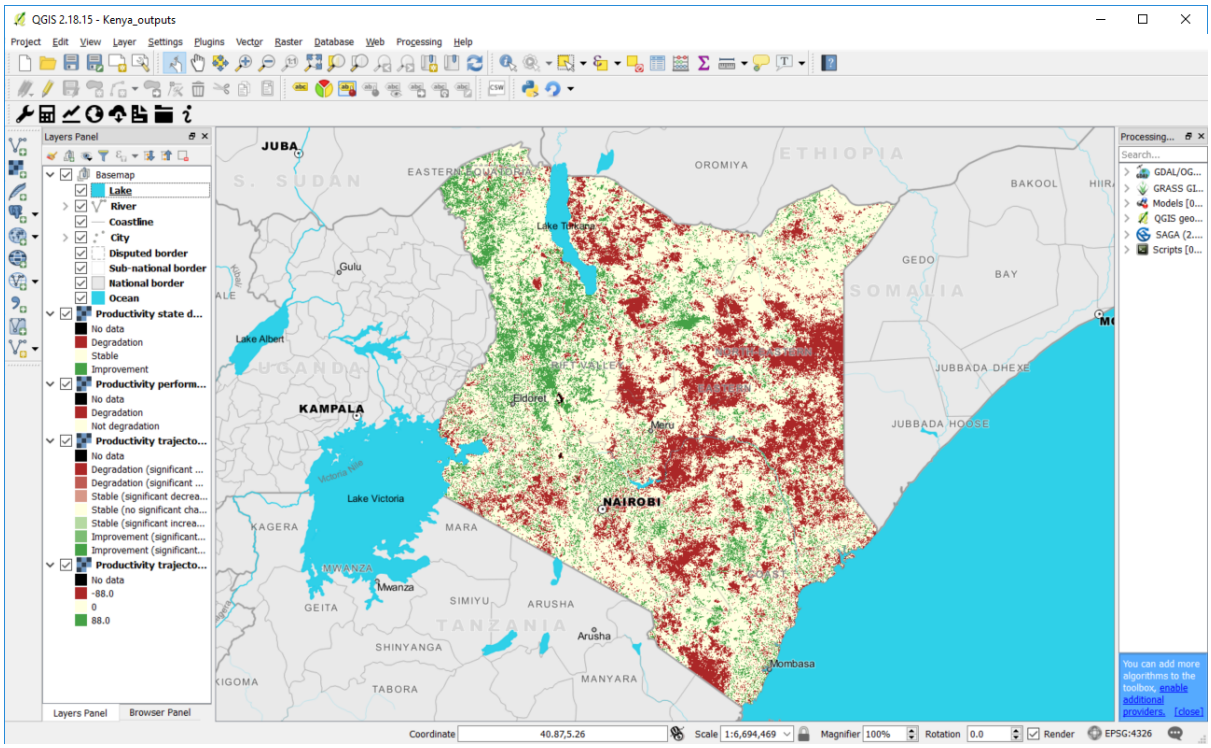


3. The next step is to write a Task name and some notes to indicate which options were selected for the analysis.



4. When all the parameters have been defined, click "Calculate", and the task will be submitted to Google Earth Engine for computing. When the task is completed (processing time will vary depending on server usage, but for most countries it takes only a few minutes most of the time), you'll receive an email notifying the successful completion.

5. When the Google Earth Engine task has completed and you received the email, click "Refresh List" and the status will show FINISHED. Click on the task and select "Download results" at the bottom of the window. A pop up window will open for you to select where to save the layer and to assign it a name. Then click "Save". The layer will be saved on your computer and automatically loaded into yoour current QGIS project.



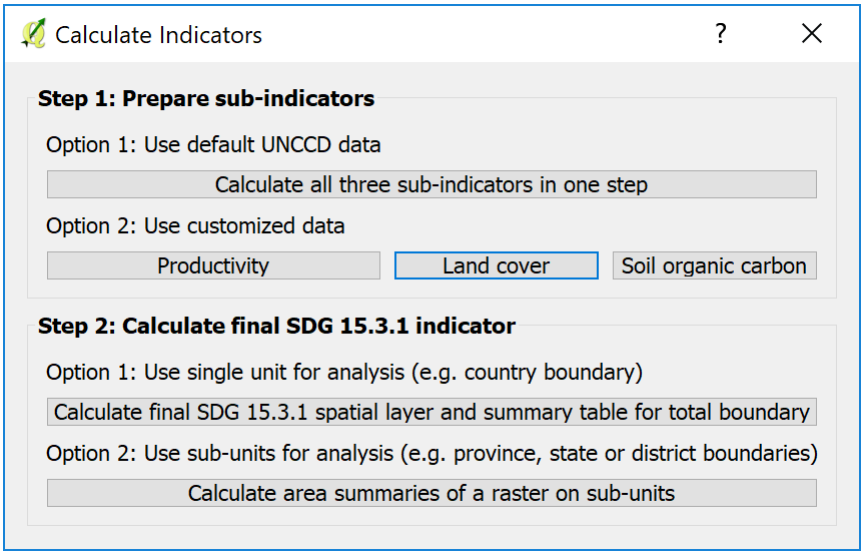
9.3 Calculate land cover

Changes in land cover is one of the indicators used to track potential land degradation which need to be reported to the UNCCD and to track progress towards SDG 15.3.1. While some land cover transitions indicate, in most cases, processes of land degradation, the interpretation of those transitions are for the most part context specific. For that reason, this indicator requires the input of the user to identify which changes in land cover will be considered as degradation, improvement or no change in terms of degradation. The toolbox allows users to calculate land cover change relative to a baseline period, enter a transition matrix indicating which transitions indicate degradation, stability or improvement.

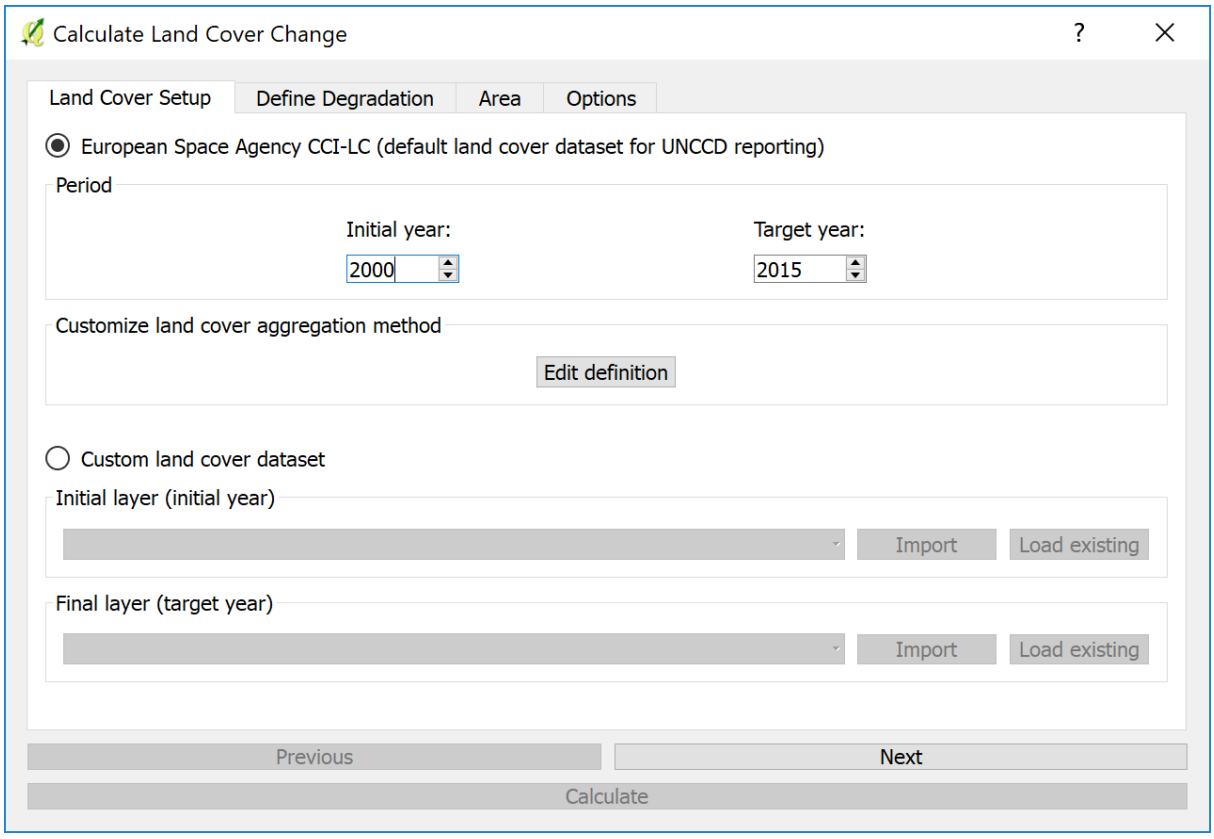
Note: Refer to the Land cover background information in this manual for a detailed explanation of how land cover change is computed.

To calculate the land cover change indicator:

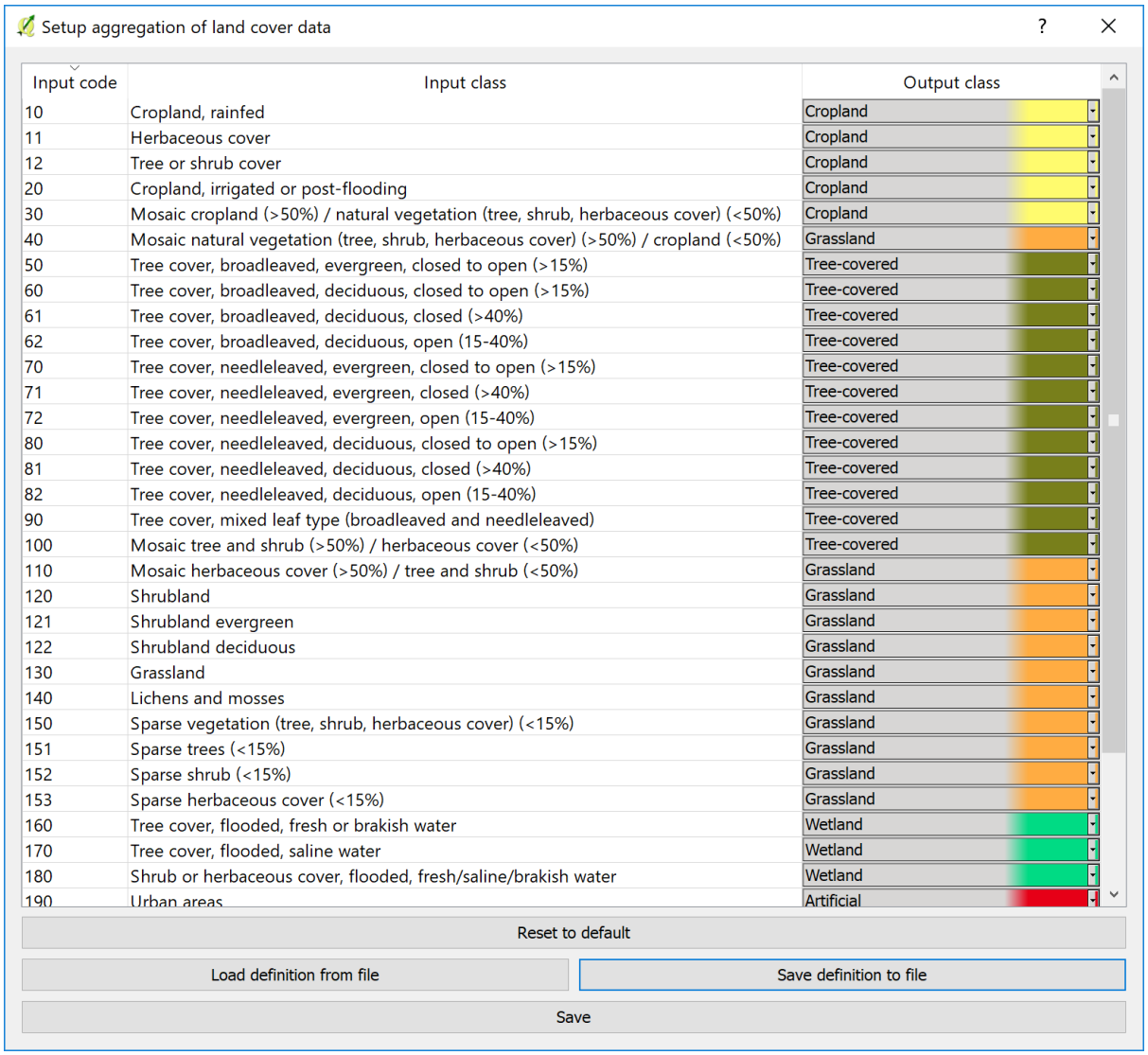
1. Click on the Calculate Indicators button from the toolbox bar, then select Land cover.



2. Within the "Land Cover Setup tab" the user selects the baseline and target years

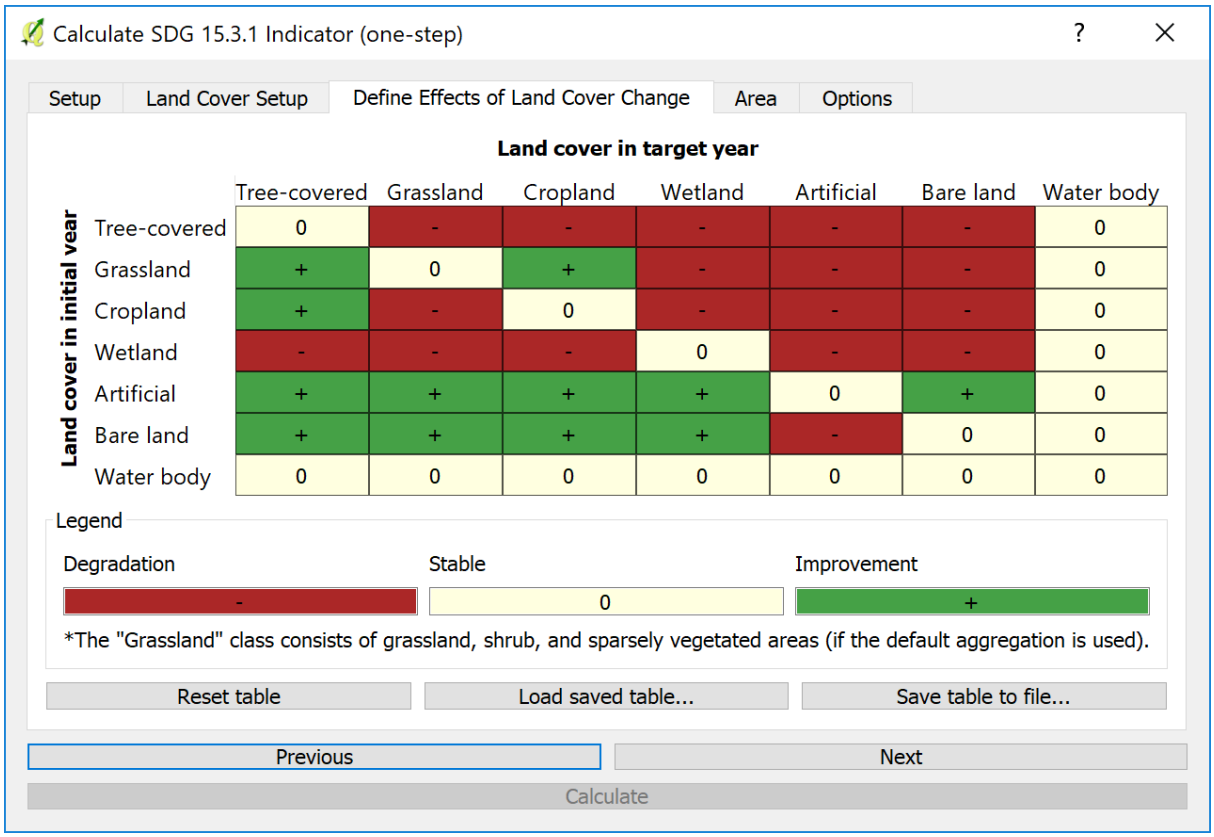


3. The land cover aggregation can be customized using the 'Edit definition' button. The user can define their own aggregation of land cover classes from the 37 ESA land cover classes to the 7 UNCCD categories.
   (a) Select the dial button for the "Custom" option and select "Create new definition"
   (b) Edit the aggregation suitable for the area of interest
   (c) Select "Save definition" and select Next



4. Within the “Define Degradation tab” user define the meaning of each land cover transition in terms of degradation. The options are: stable (0), degradation (-) or improvement (+). For example, the default for cropland to cropland is 0 because the land cover stays the same and is therefore stable. The default for forest to cropland is -1 because forest is likely cut to clear way for agriculture and would be considered deforestation. The user is encouraged to thoroughly evaluate the meaning of each transition based on their knowledge of the study area, since this matrix will have an important effect on the land degradation identified by this subindicator.

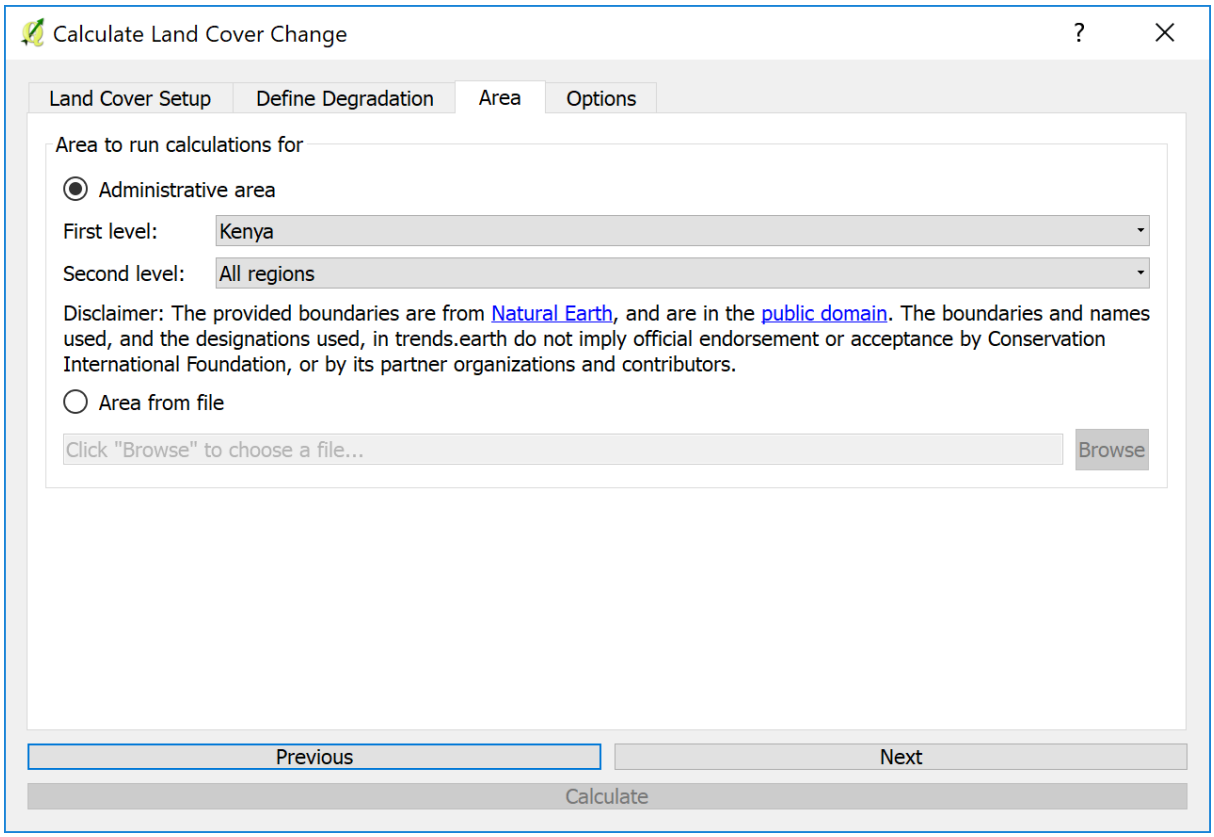
   Users can keep the default values or create unique transition values of their own.



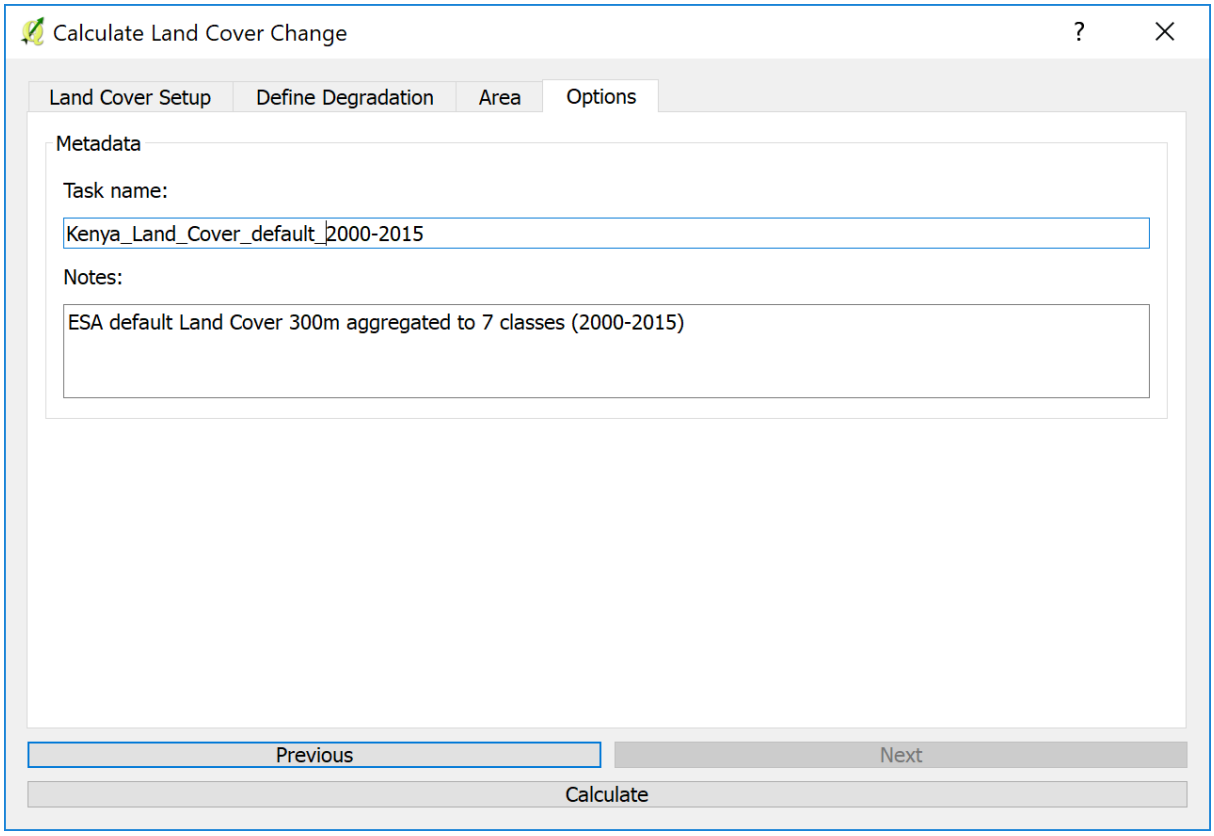
5. The next step is to define the study area on which to perform the analysis. The toolbox allows this task to be completed in one of two ways:

   (a) The user selects first (i.e. country) and second (i.e. province or state) administrative boundary from a drop-down menu.

   (b) The user can upload a shapefile with an area of interest.



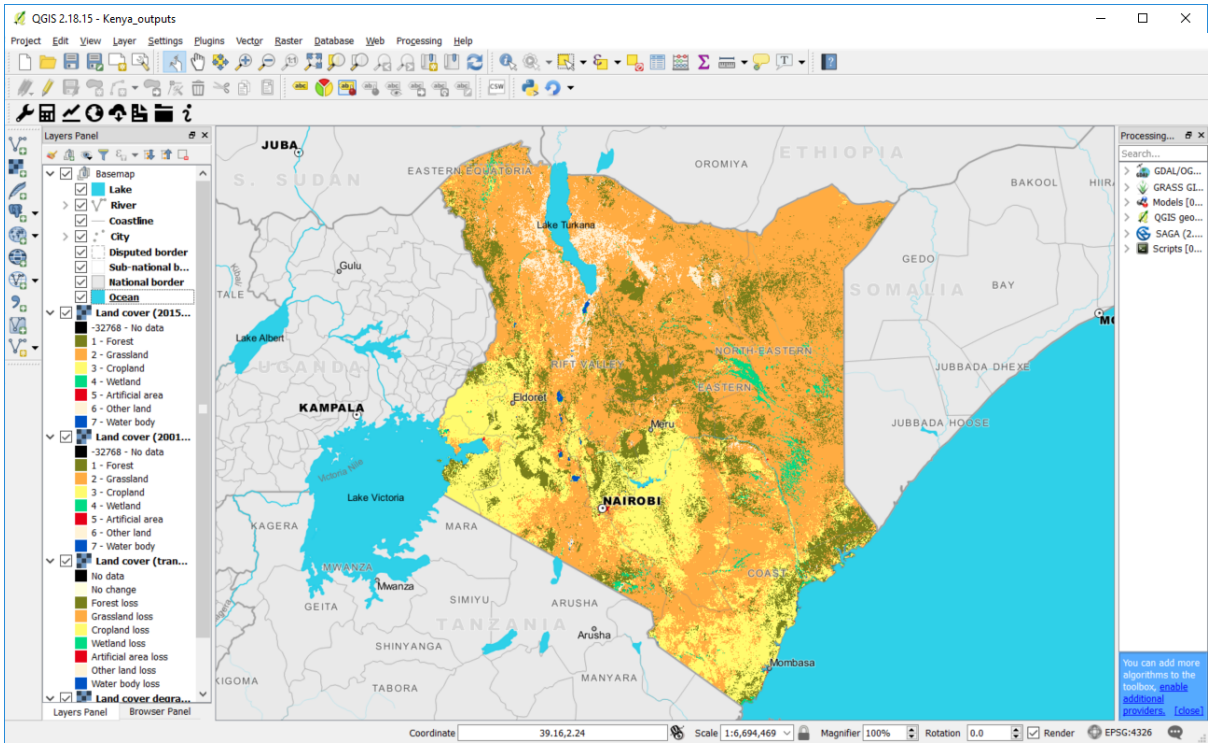
6. The next step is to add the task name and relevant notes for the analysis.



7. When all the parameters have been defined, click "Calculate", and the task will be submitted to Google Earth Engine for computing. When the task is completed (processing time will vary depending on server usage, but for most countries it takes only a few minutes most of the time),

you'll receive an email notifying the successful completion.

8. When the Google Earth Engine task has completed and you received the email, click "Refresh List" and the status will show FINISHED. Click on the task and select "Download results" at the bottom of the window. A pop up window will open for you to select where to save the layer and to assign it a name. Then click "Save". The layer will be saved on your computer and automatically loaded into yoour current QGIS project.

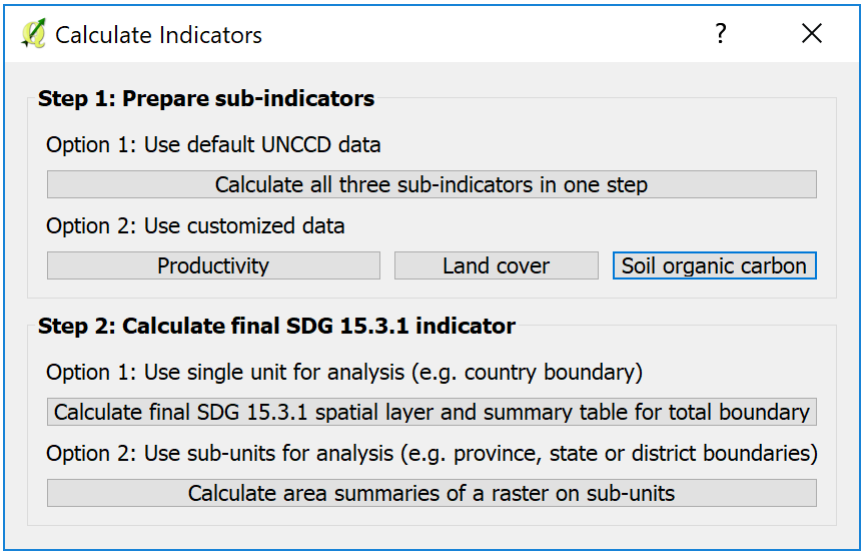


9.4 Calculate soil carbon

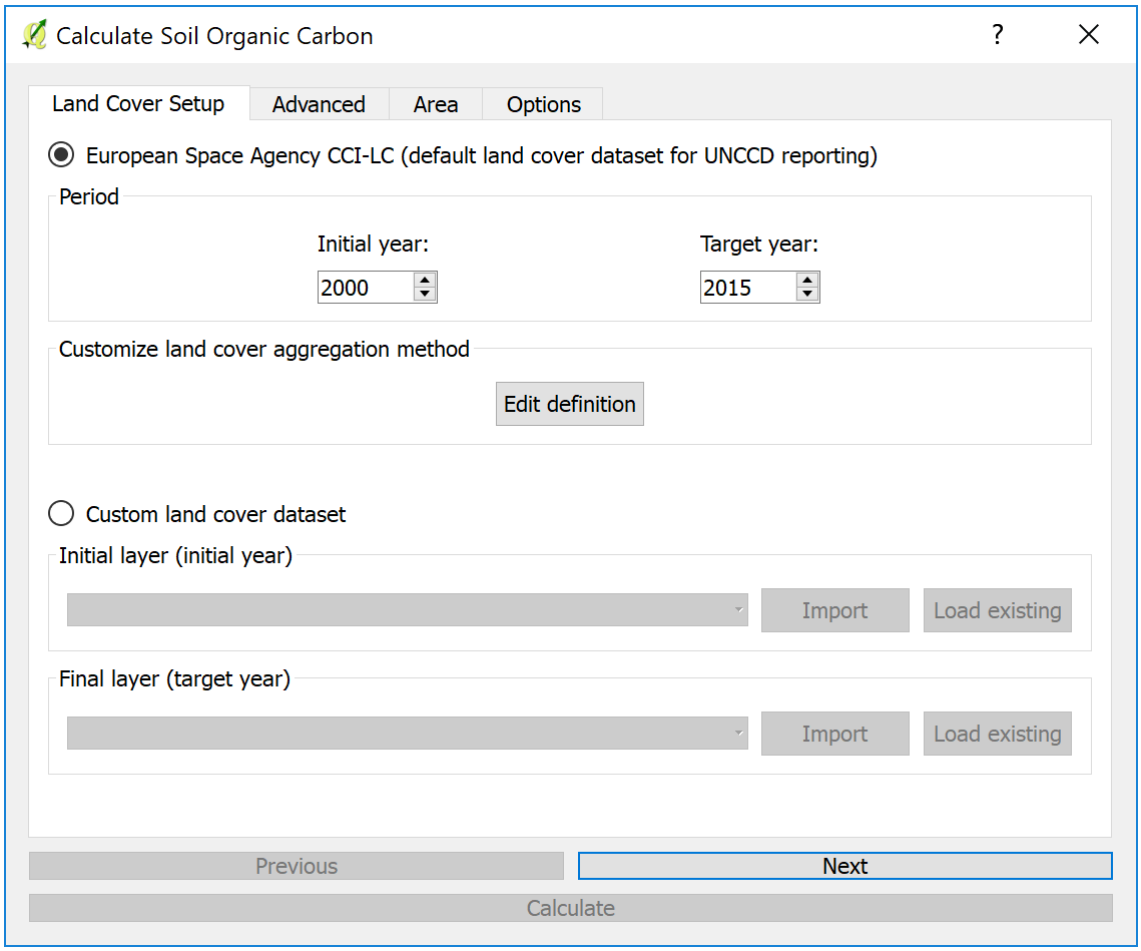
Soil Organic Carbon is calculated as a proxy for carbon stocks. It is measured using soil data and changes in land cover.

Note: Refer to the Soil organic carbon background information in this manual for a detailed explanation of how soil organic carbon change is computed.

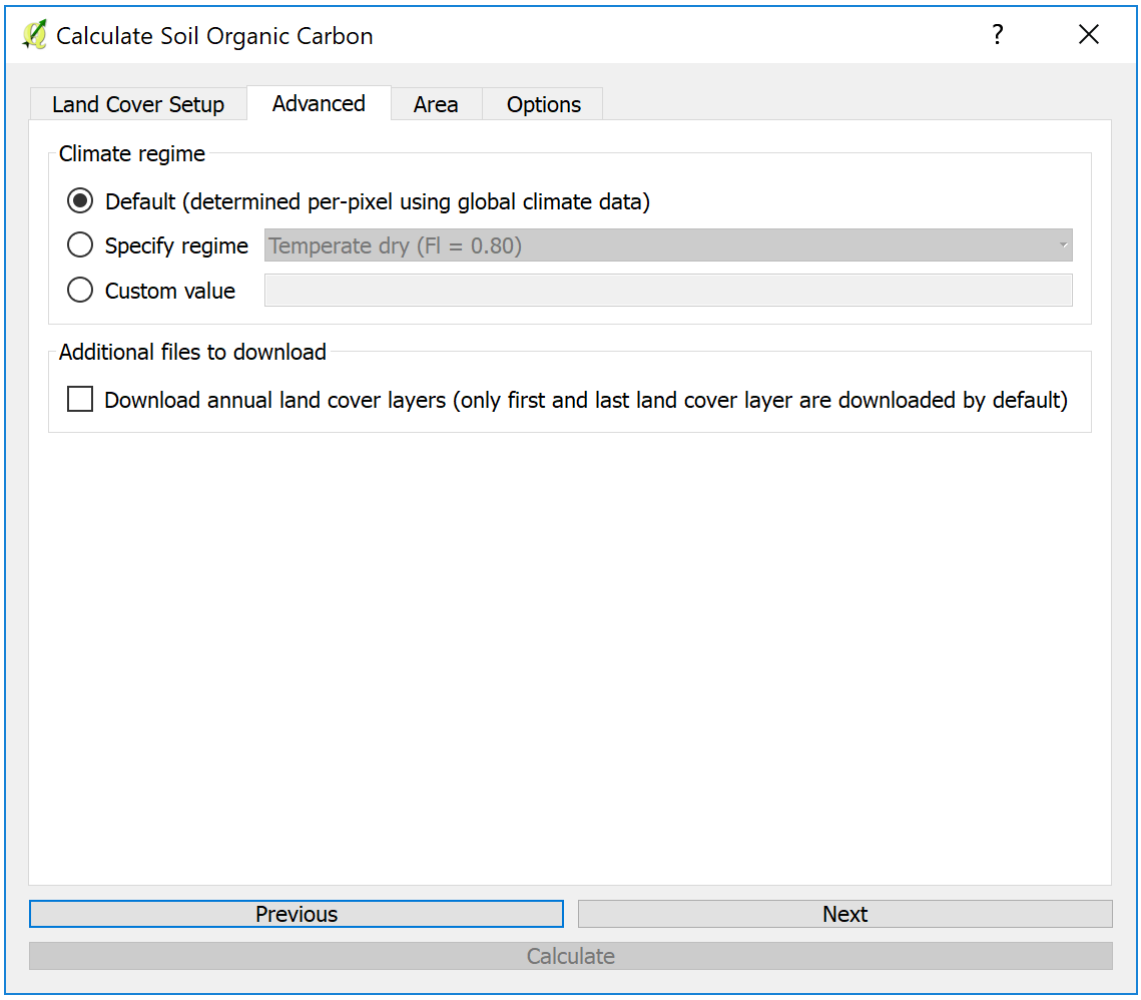
To calculate degradation in soil organic carbon:



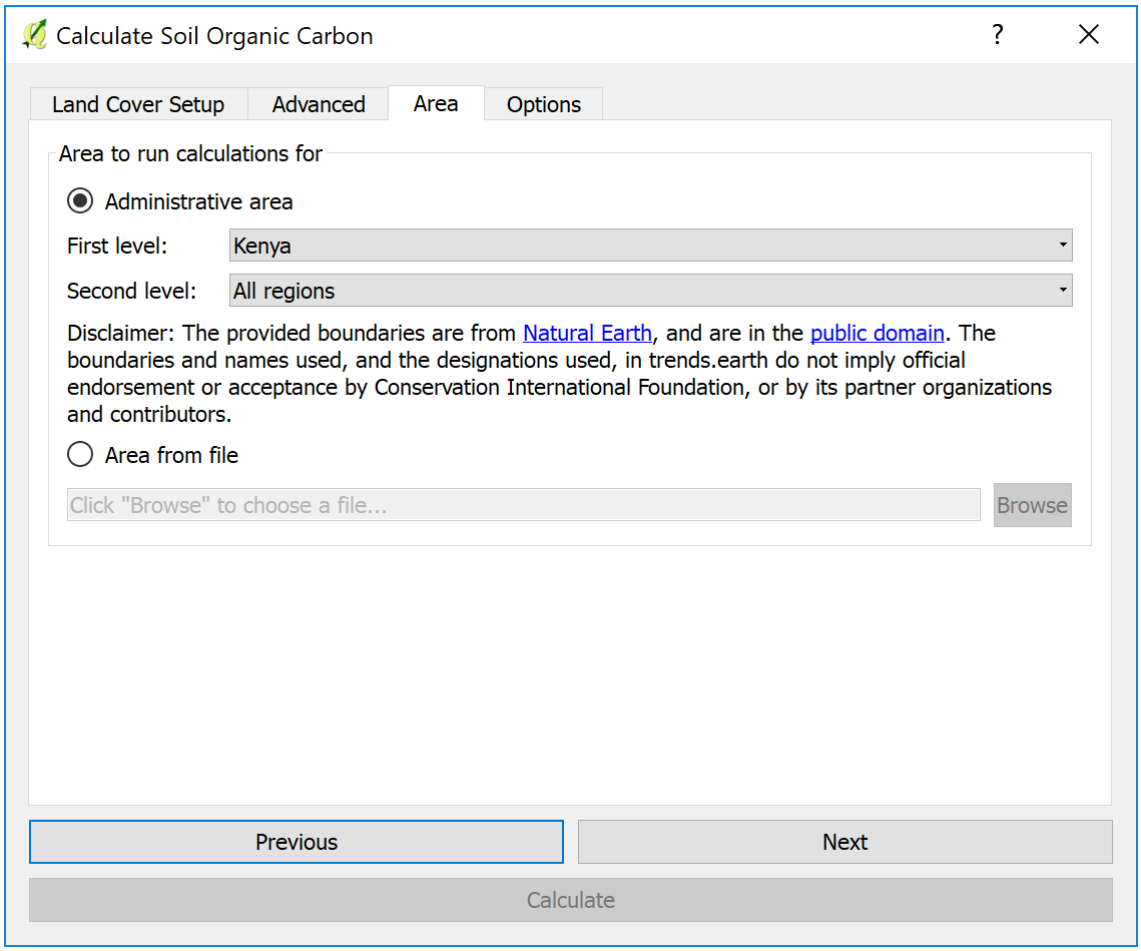
1. Select Soil organic carbon button under Calculate Indicators



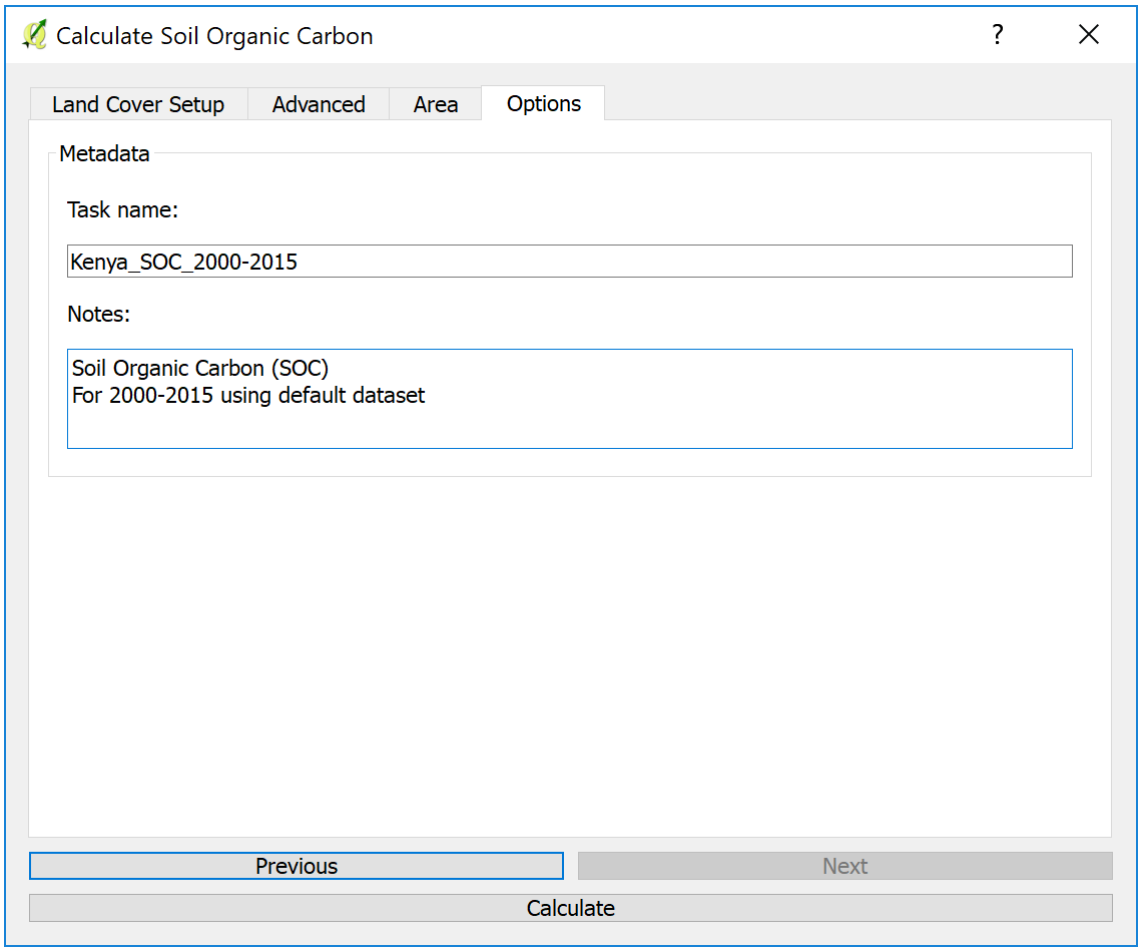
2. The Land Cover Setup tab allows the user to define the period for analysis with the baseline and target year. Users can select the Edit definition button to change the land cover aggregation method or upload a datasets.



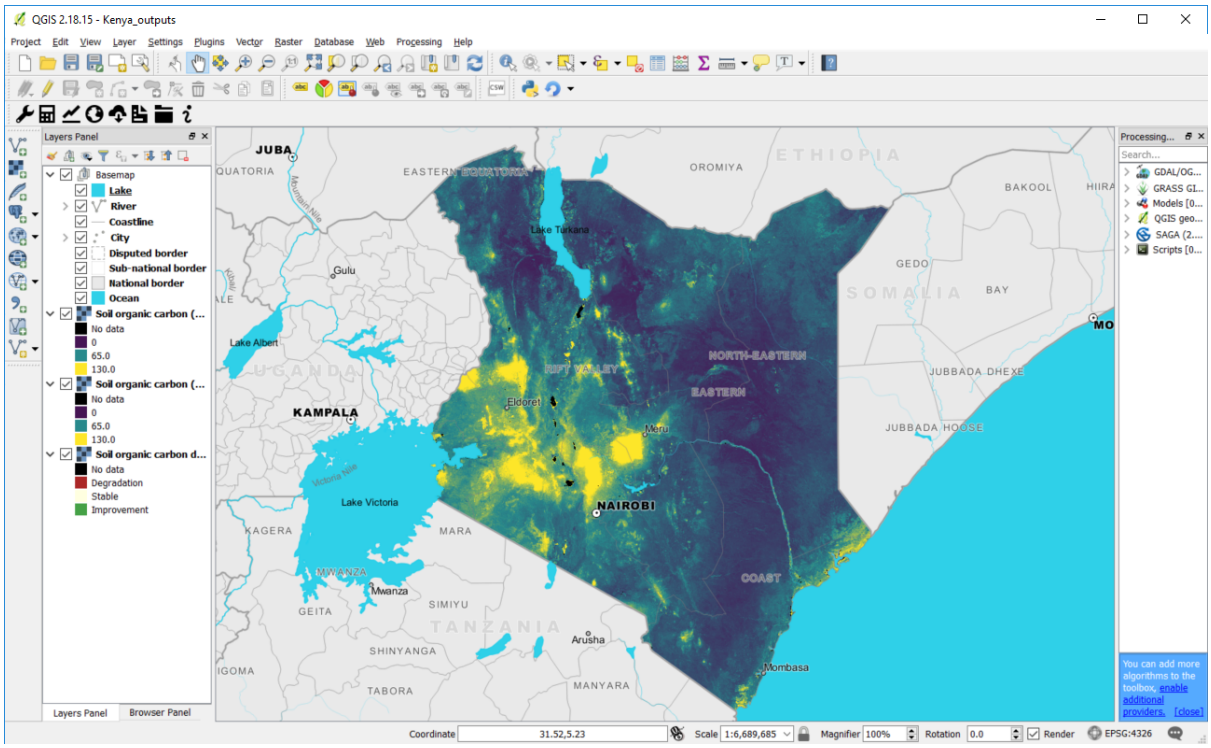
3. The "Advanced" tab allows users to specify the Climate regime.



4. Users can select an area or upload a polygon shapefile for analysis



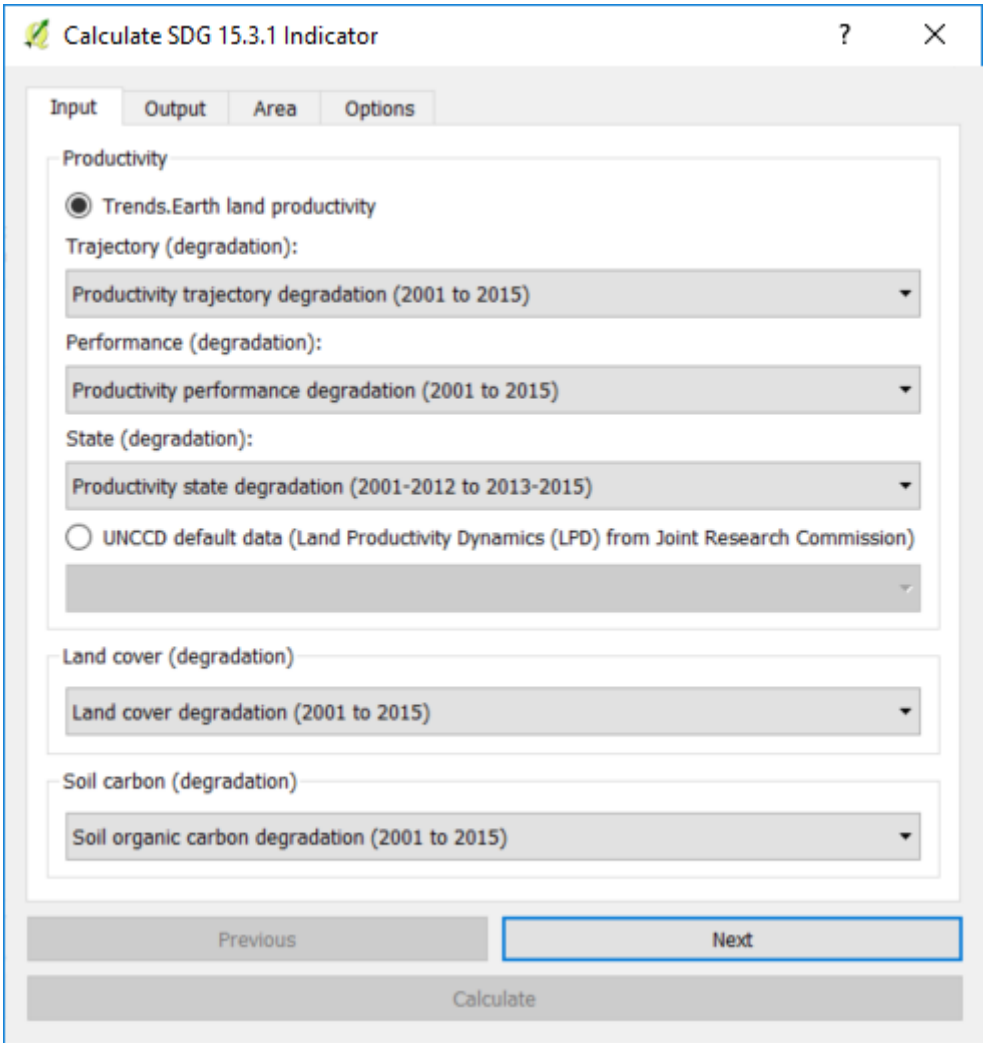
6. The next step is to add the task name and relevant notes for the analysis.
7. When all the parameters have been defined, click "Calculate", and the task will be submitted to Google Earth Engine for computing. When the task is completed (processing time will vary depending on server usage, but for most countries it takes only a few minutes most of the time), you'll receive an email notifying the successful completion.
8. When the Google Earth Engine task has completed and you received the email, click "Refresh List" and the status will show FINISHED. Click on the task and select "Download results" at the bottom of the window. A pop up window will open for you to select where to save the layer and to assign it a name. Then click "Save". The layer will be saved on your computer and automatically loaded into yoour current QGIS project.



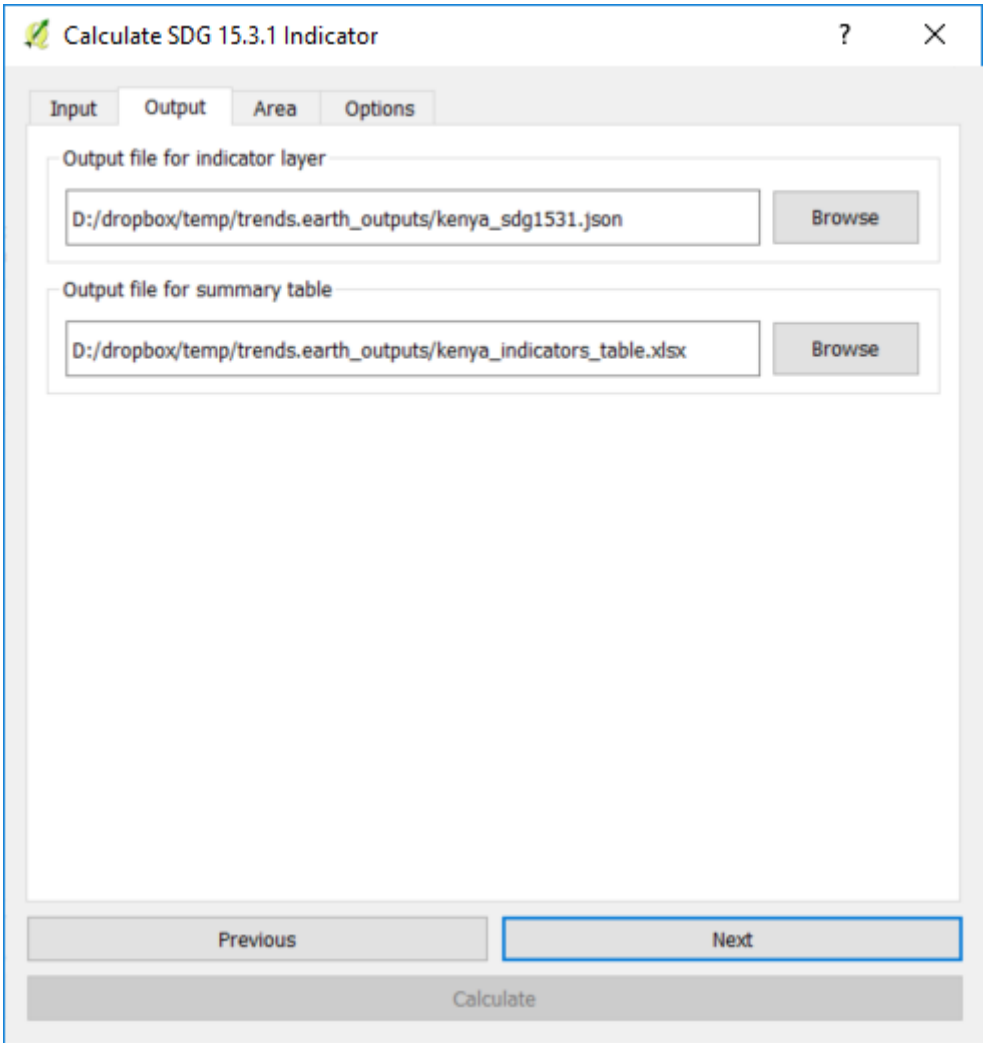
9.5 Compute SDG Indicator 15.3.1

Note: Refer to the Combining Productivity Indicators section of this manual for a detailed explanation of how the sub-indicators are combined to calculate the final SDG 15.3.1 indicator.

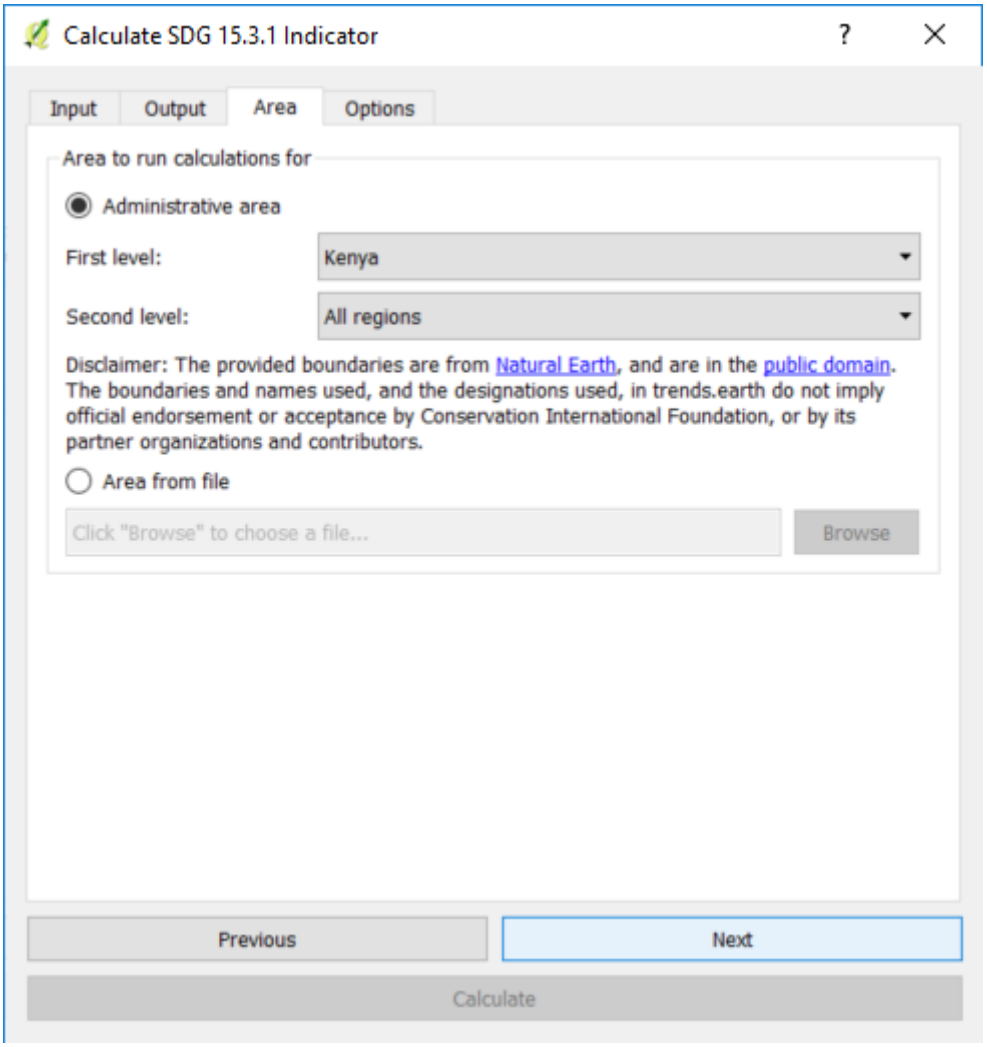
1. Once you have computed the three sub-indicators (productivity, land cover and soil organic carbon), and they are loaded into the QGIS project. Click on the Calculate icon ( ). This will open up the "Calculate Indicator" dialog box. This time click on Step 2 "Calculate final SDG 15.3.1 indicator and summary table".
2. The input window will open already populated with the correct sub-indicators (that if you have them loaded to the QGIS map)



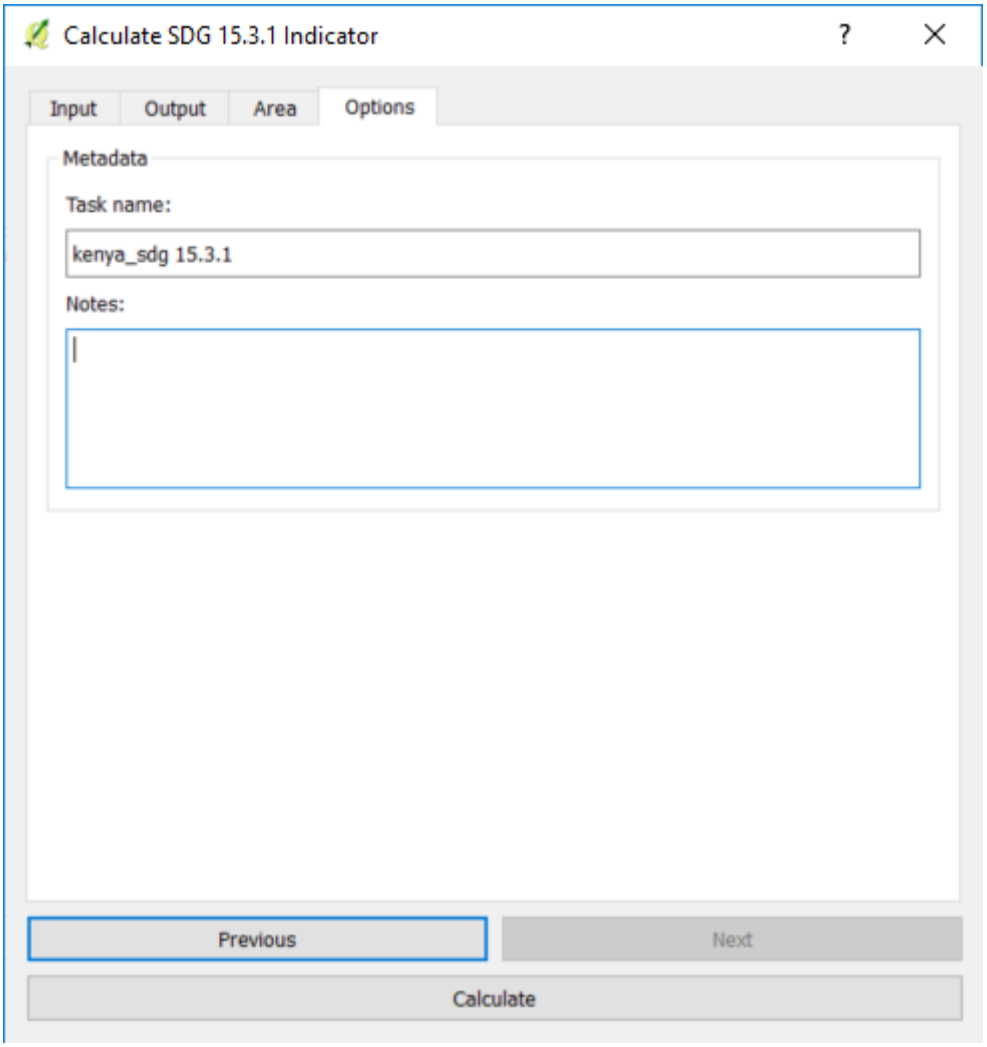
3. Select the name and location where to save the output raster layer and the excel file with the areas computed.



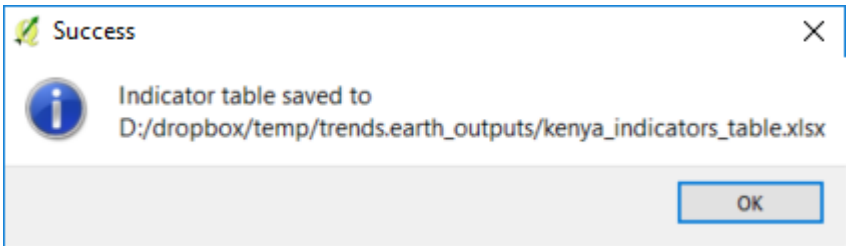
4. Define the area of analysis. In this example, the country boundary.



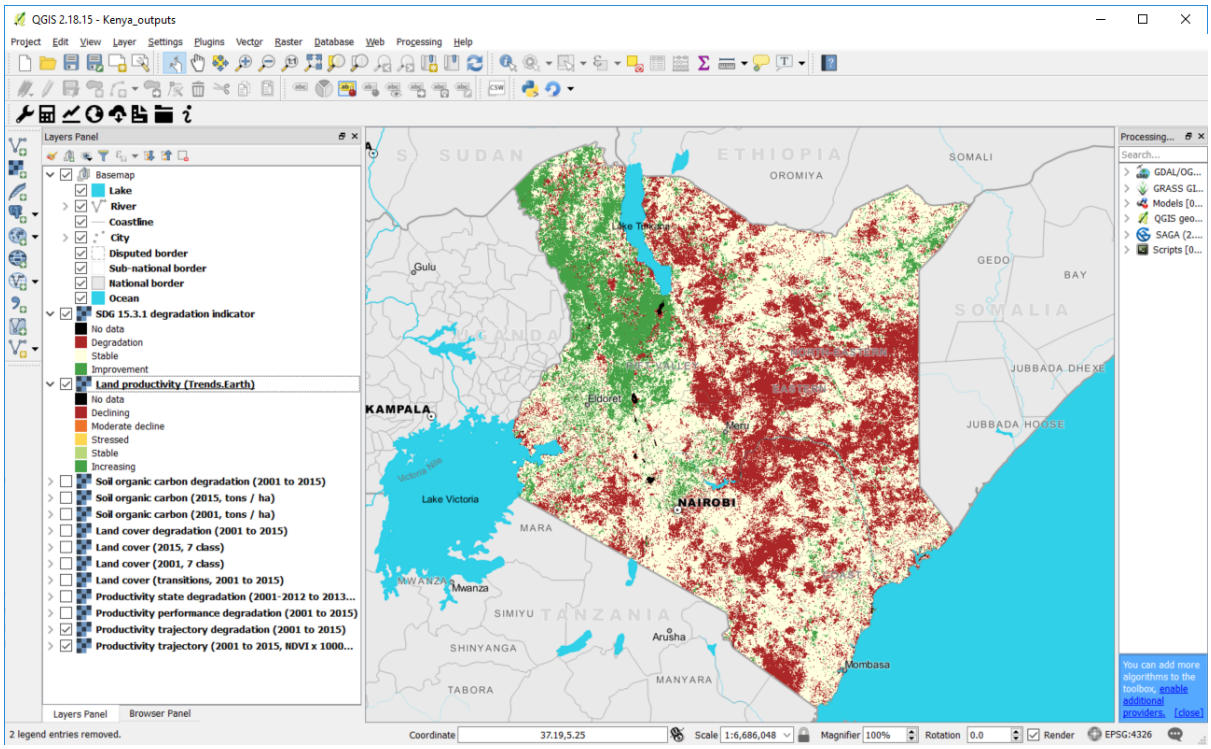
5. Give a name to the task and click “Calculate”



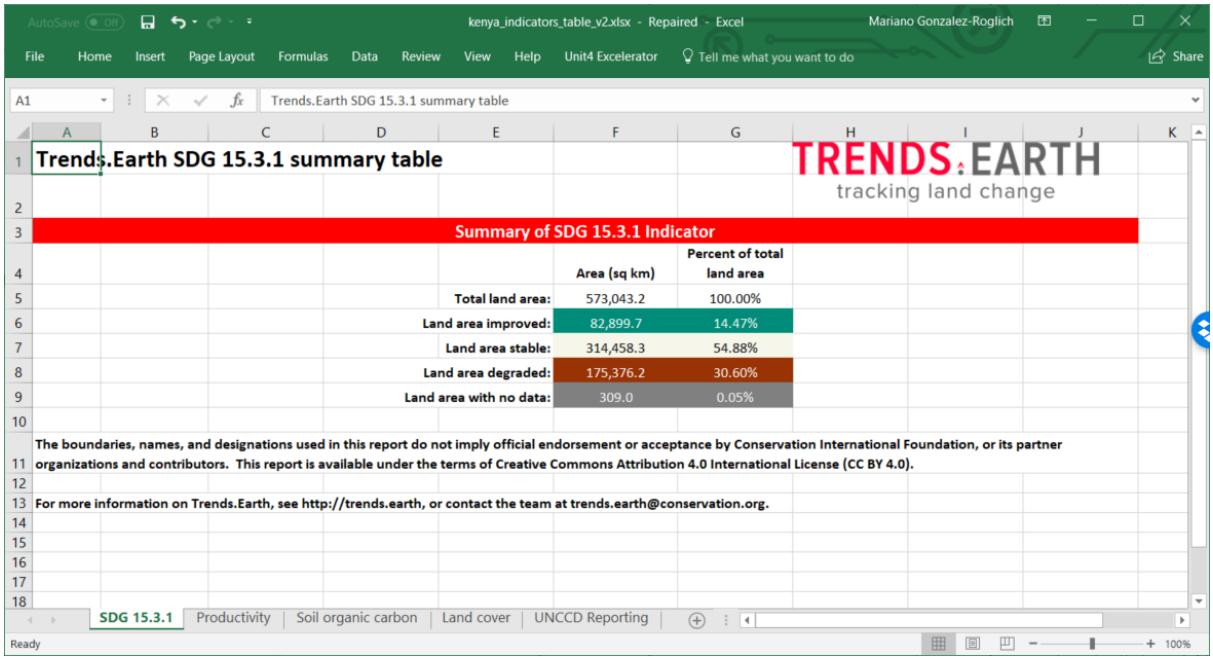
6. This calculation is run on your computer, so depending on the size of the area and the computing power of your computer, it could take a few minutes. When completed, the final SDG indicator will be loaded into the QGIS map and the Excel file with the areas will be saved in the folder you selected. when done, a message will pop up.



7. Click OK and two layers will be loaded to your map: the 5 classes productivity and the SDG 15.3.1 indicators.

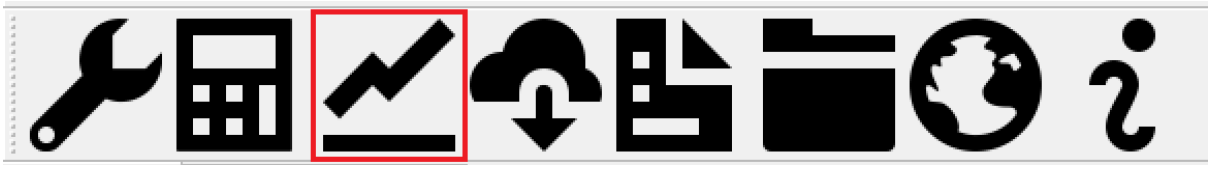


8. If you navigate to the folder you selected for storing the files, you can open the Excel files with the areas computed for each of the sub-indicators and the final SDG. NOTE: You may get an error message when opening the file, just click ok and the file will open regardless. We are working to fix this error.



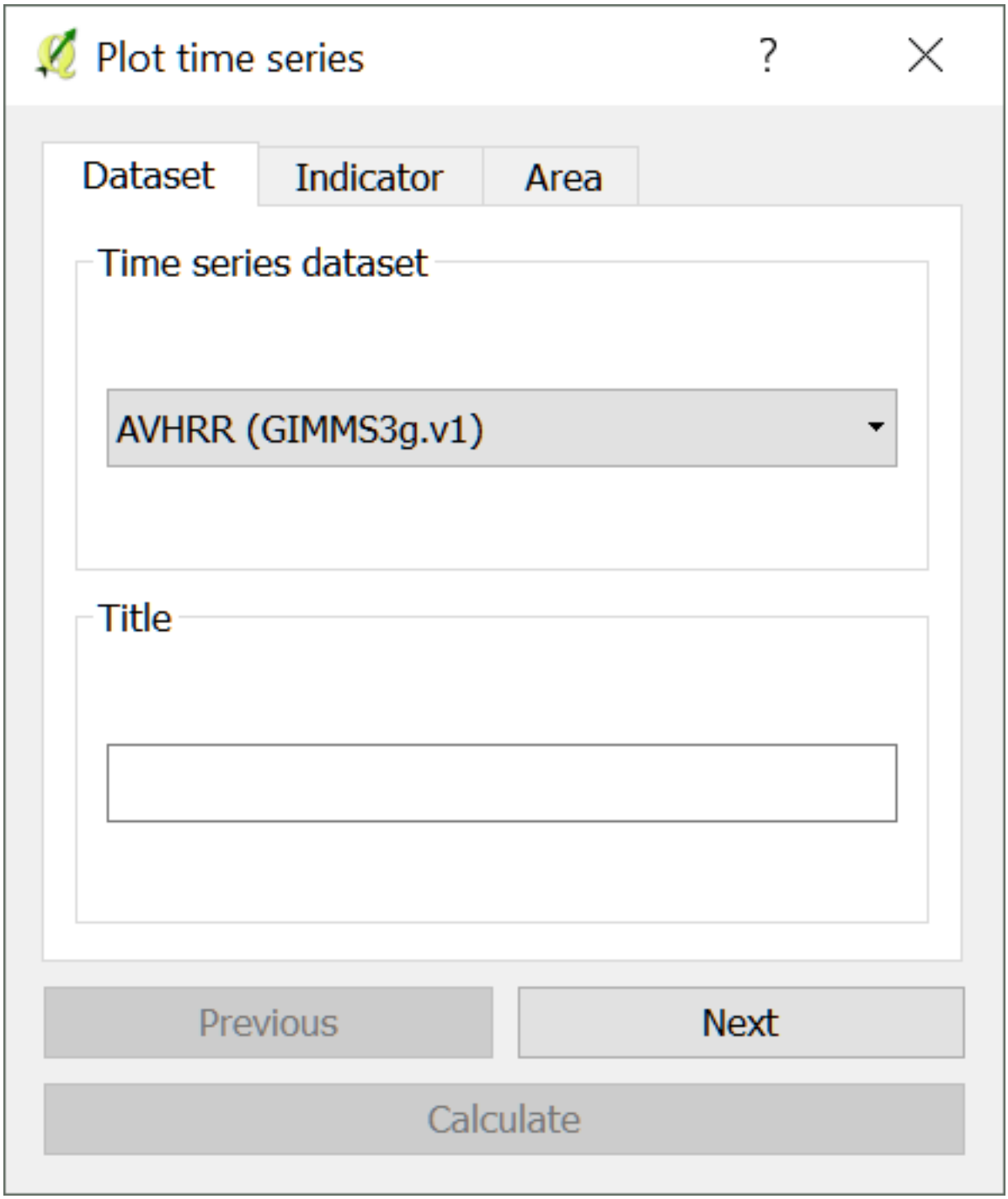
CHAPTER 10

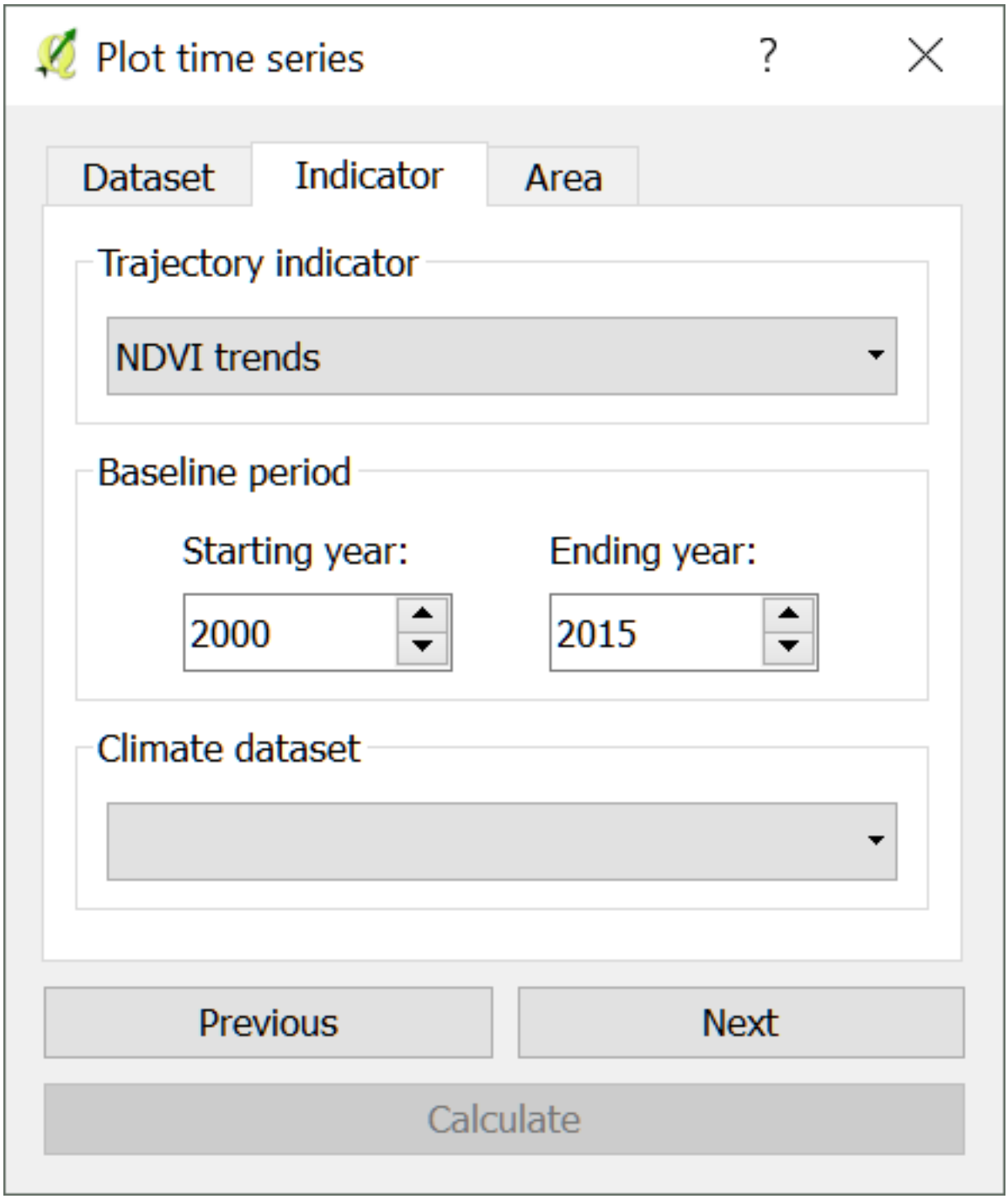
Plot data

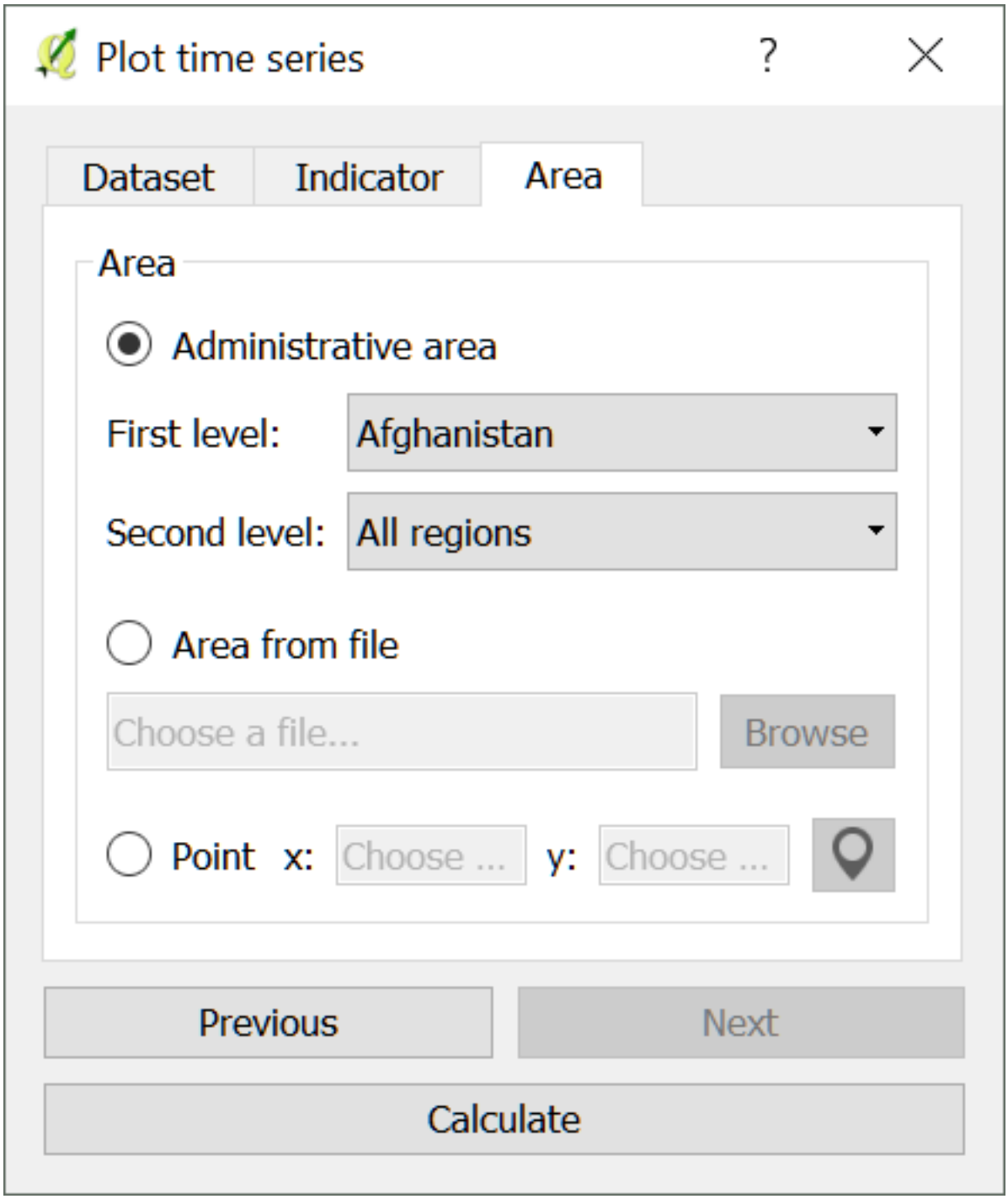


To view plotted time series, select the graph icon ( ). This will open up the Plot data dialog box:

The toolbox also supports plotting time series showing how a particular indicator has changed over time. To use this feature, click on the Plot data button from the toolbox bar. Then select a dataset, indicator, and area to plot:

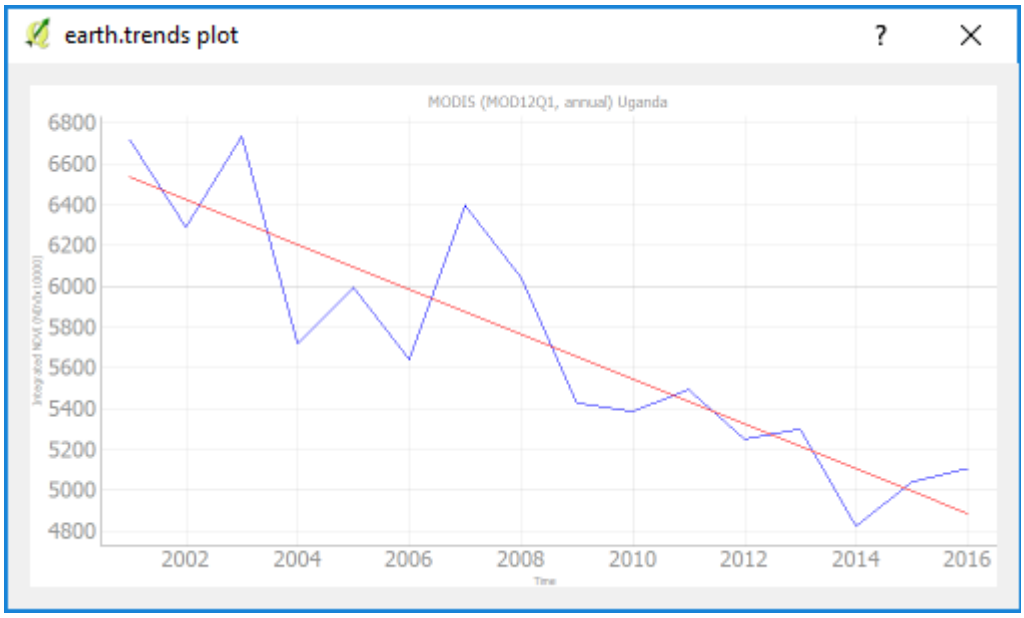

Plot time series
?
Dataset
Indicator
Area
Time series dataset
AVHRR (GIMMS3g.v1)
Title
Previous
Next
Calculate


Plot time series
?
Dataset
Indicator
Area
Trajectory indicator
NDVI trends
Baseline period
Starting year:
Ending year:
2000
2015
Climate dataset
Previous
Next
Calculate



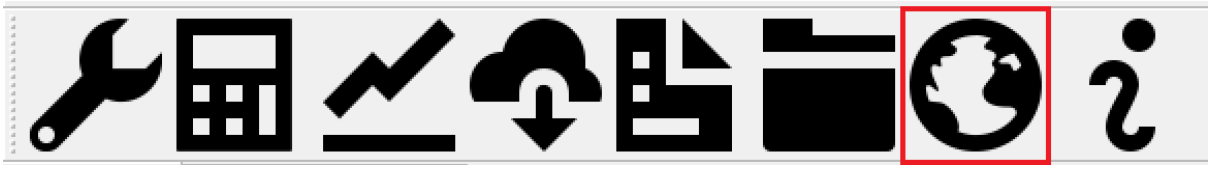
When all the parameters have been defined, click Calculate, and the task will be submitted to Google Earth Engine for computing. When the task is completed (processing time will vary depending on server usage, but for most countries it takes only a few minutes most of the time), you'll receive an email notifying you of the successful completion of the task.

Use the View Google Earth Egngine tasks tool described above to download and plot the results:


earth.trends plot
?
MODIS (MOD12Q1, annual) Uganda
6800
6600
6400
6200
6000
5800
5600
5400
5200
5000
4800
2002
2004
2006
2008
2010
2012
2014
2016

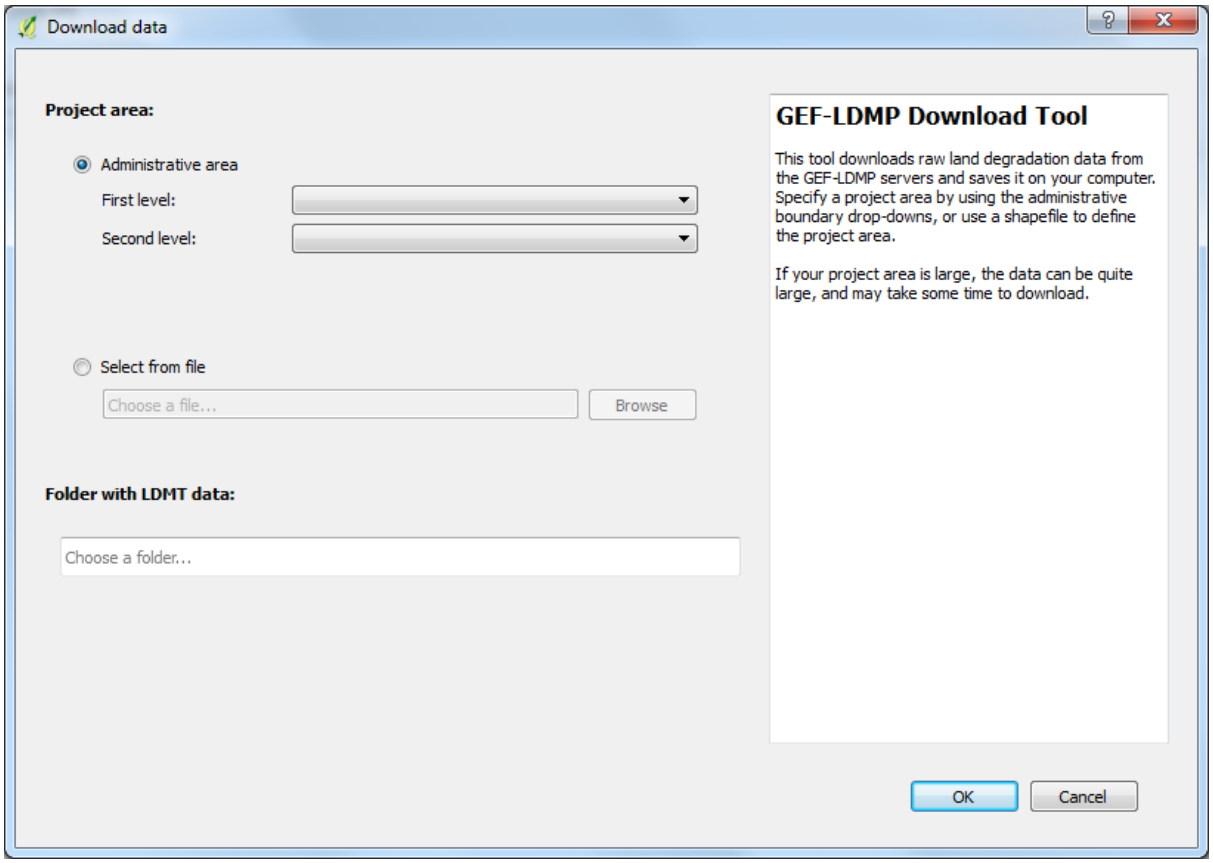
CHAPTER 11

Download data



To download data, select the globe icon ( ). This will open up the "Download Data" dialog box:

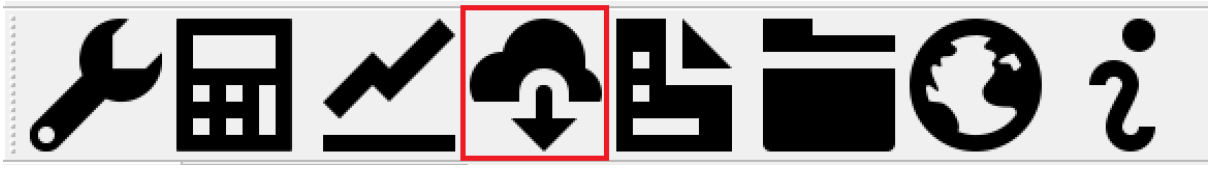
If you would like to work with the original raw data used in TRENDS.EARTH, you can select select an area of interest and download the desired data for further analysis.



The table below describes all the data available through the toolbox. It specifies data sources, resolutions, coverage and the different indicators for which each data set is used.

CHAPTER 12

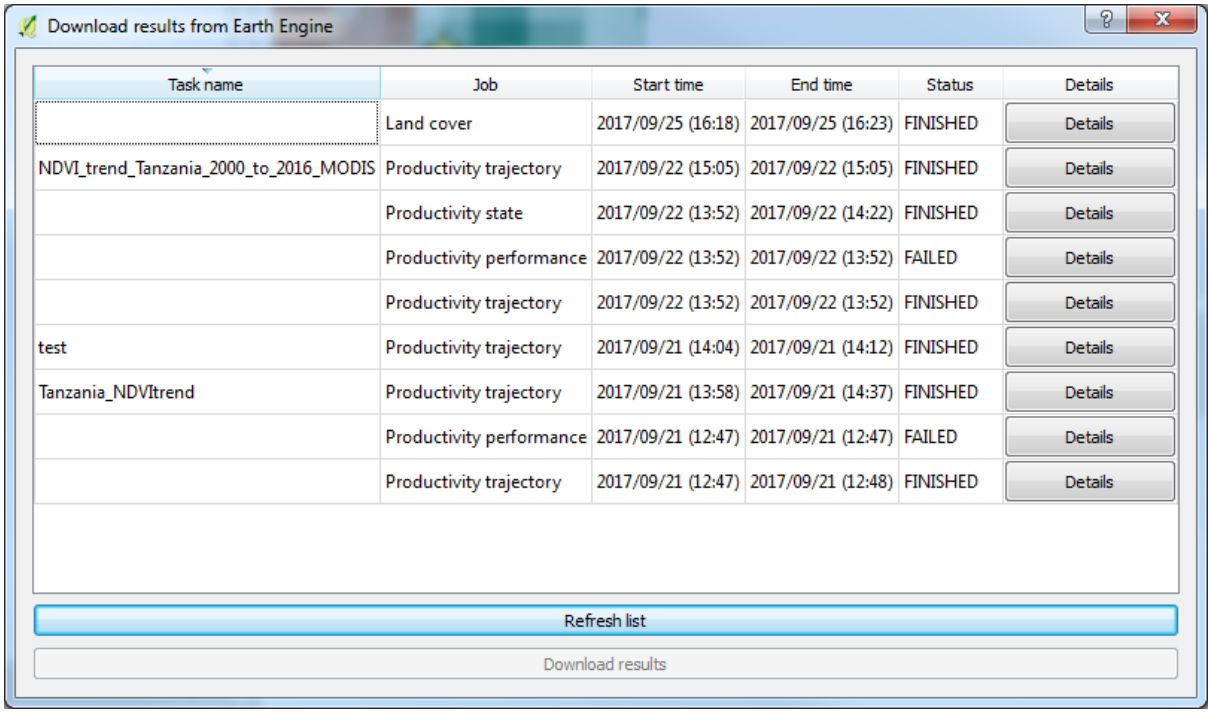
View and download results

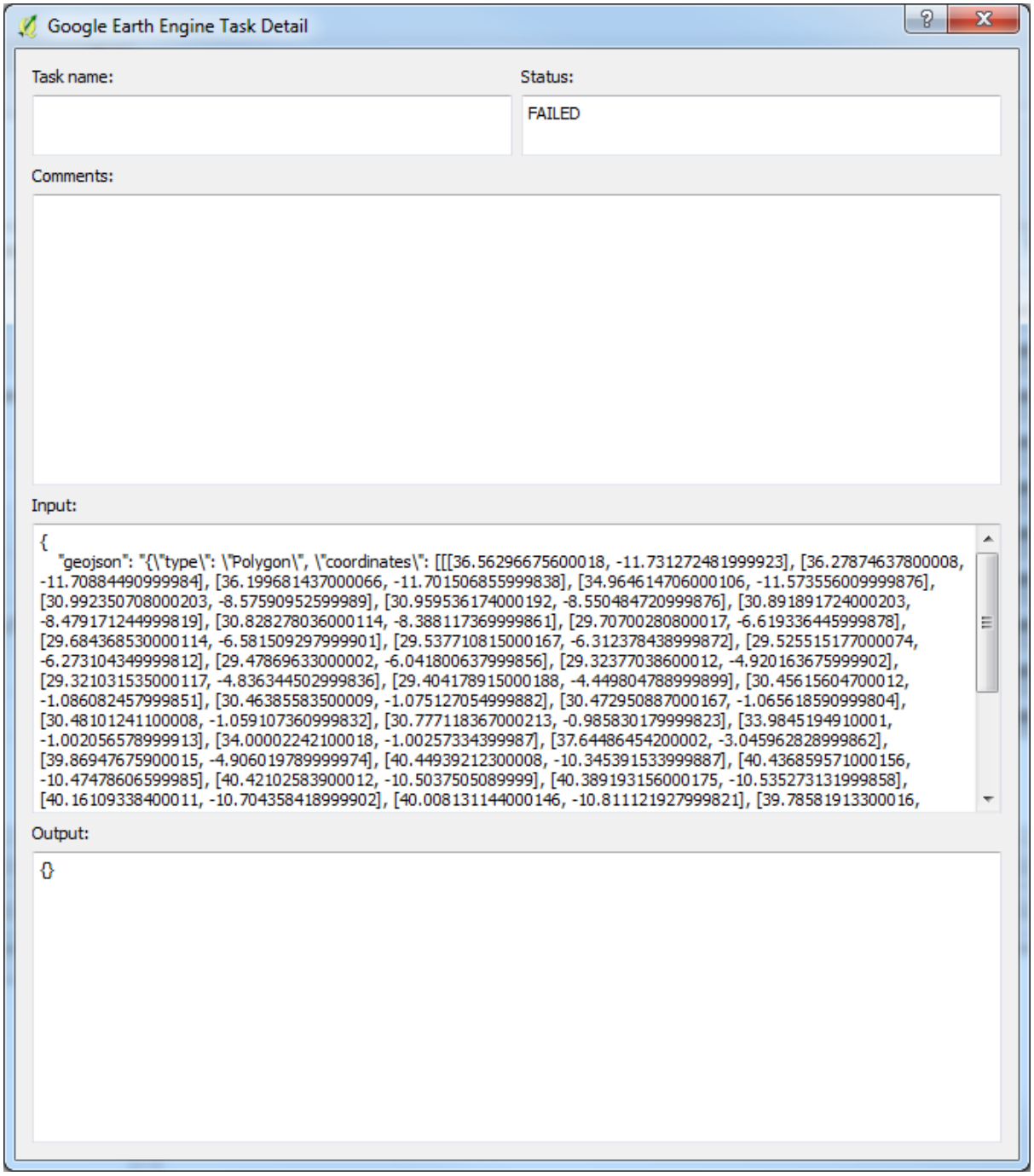


Once you have submitted a calculation using TRENDS.EARTH, it is sent to Google Earth Engine to run the calculations in the cloud. To view the Google Earth Engine (GEE) tasks you have running, and to download your results, select the cloud with the arrow facing down icon ( ). This will open up the Download results from Earth Engine dialog box.

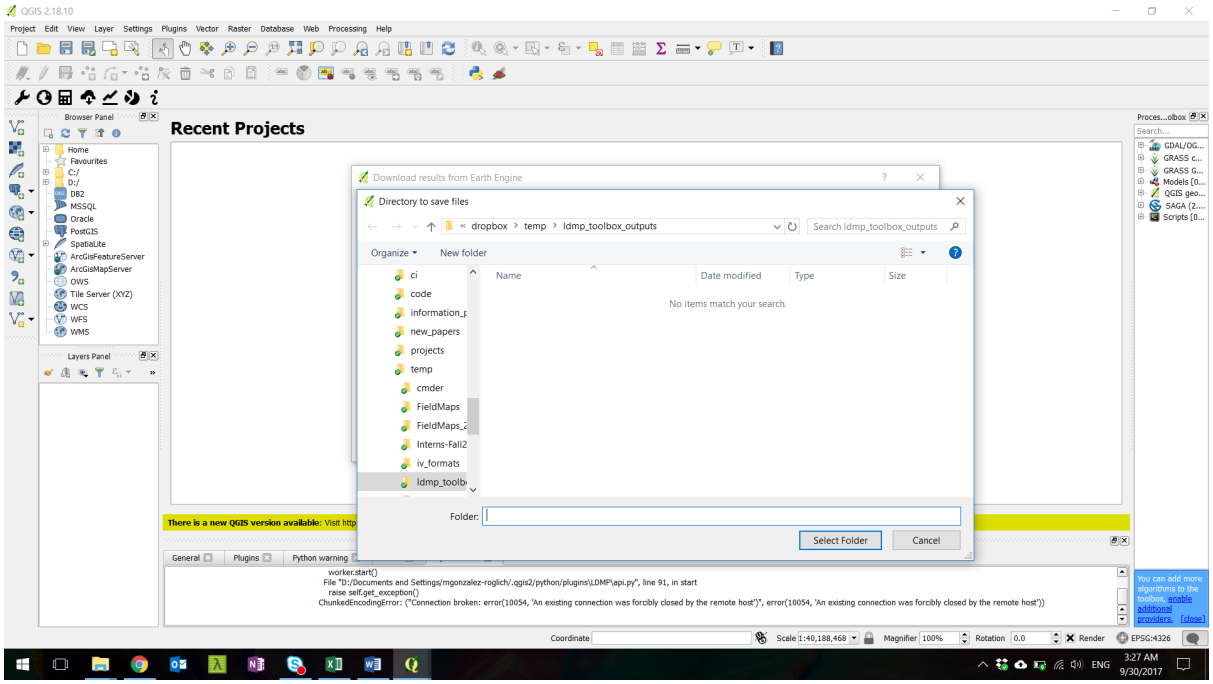
Click Refresh List to show all the tasks you have submitted and their status.

Users can view their current and previous tasks here. the table shows the task name provided by the user, which analysis is running (job), the start time and end time of when the task was started and completed and whether or not the task was successful. The Details page outlines the different options the user chose for each task.


Download results from Earth Engine
Task name
Job
Start time
End time
Status
Details
Land cover 2017/09/25 (16:18) 2017/09/25 (16:23) FINISHED Details
NDVI_trend_Tanzania_2000_to_2016_MODIS Productivity trajectory 2017/09/22 (15:05) 2017/09/22 (15:05) FINISHED Details
Productivity state 2017/09/22 (13:52) 2017/09/22 (14:22) FINISHED Details
Productivity performance 2017/09/22 (13:52) 2017/09/22 (13:52) FAILED Details
Productivity trajectory 2017/09/22 (13:52) 2017/09/22 (13:52) FINISHED Details
test Productivity trajectory 2017/09/21 (14:04) 2017/09/21 (14:12) FINISHED Details
Tanzania_NDVItrend Productivity trajectory 2017/09/21 (13:58) 2017/09/21 (14:37) FINISHED Details
Productivity performance 2017/09/21 (12:47) 2017/09/21 (12:47) FAILED Details
Productivity trajectory 2017/09/21 (12:47) 2017/09/21 (12:48) FINISHED Details
Refresh list
Download results

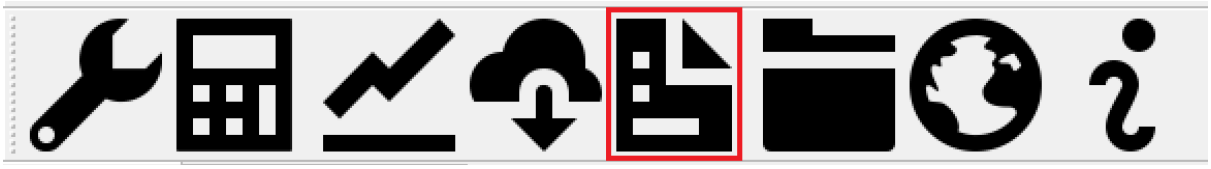


To download results to the computer once a task has finished, click on the task you are interested in downloading results for, then click Download results. In the window that appears, choose the location in which to save the download. Note that some downloads might consist of multiple files - all of these files need to be kept together if the results are moved to a different location on the computer (or saved to a USB stick).

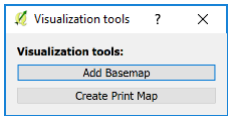

QGIS 2.18.10
Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Help
Browser Panel
Recent Projects
Layers Panel
Download results from Earth Engine
Directory to save files
dropbox › temp › ldmp_toolbox_outputs
Search ldmp_toolbox_outputs
Organize
New folder
Name
Date modified
Type
Size
No items match your search.
ci
code
information_s
new_papers
projects
temp
cmder
FieldMaps
FieldMaps_2
Interns-Fall2
iv_formats
ldmp_toolbo
Folder:
Select Folder
Cancel
There is a new QGIS version available: Visit http
General
Plugins
Python warning
worker.start()
File "D:/Documents and Settings/mgonzalez-roglich/.qgis2/python/plugins\LDMP\api.py", line 91, in start
raise self.get_exception()
ChunkedEncodingError: ("Connection broken: error(10054, 'An existing connection was forcibly closed by the remote host')", error(10054, 'An existing connection was forcibly closed by the remote host'))
Coordinate
Scale 1:40,188,468
Magnifier 100%
Rotation 0.0
Render
EPSG:4326
ENG
3:27 AM
9/30/2017

CHAPTER 13

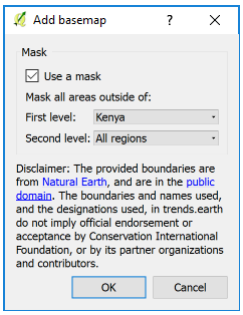
Visualization tools



To view the "Visualization Tools", select the report icon (). This will open up the "Visualization tools" dialog box:



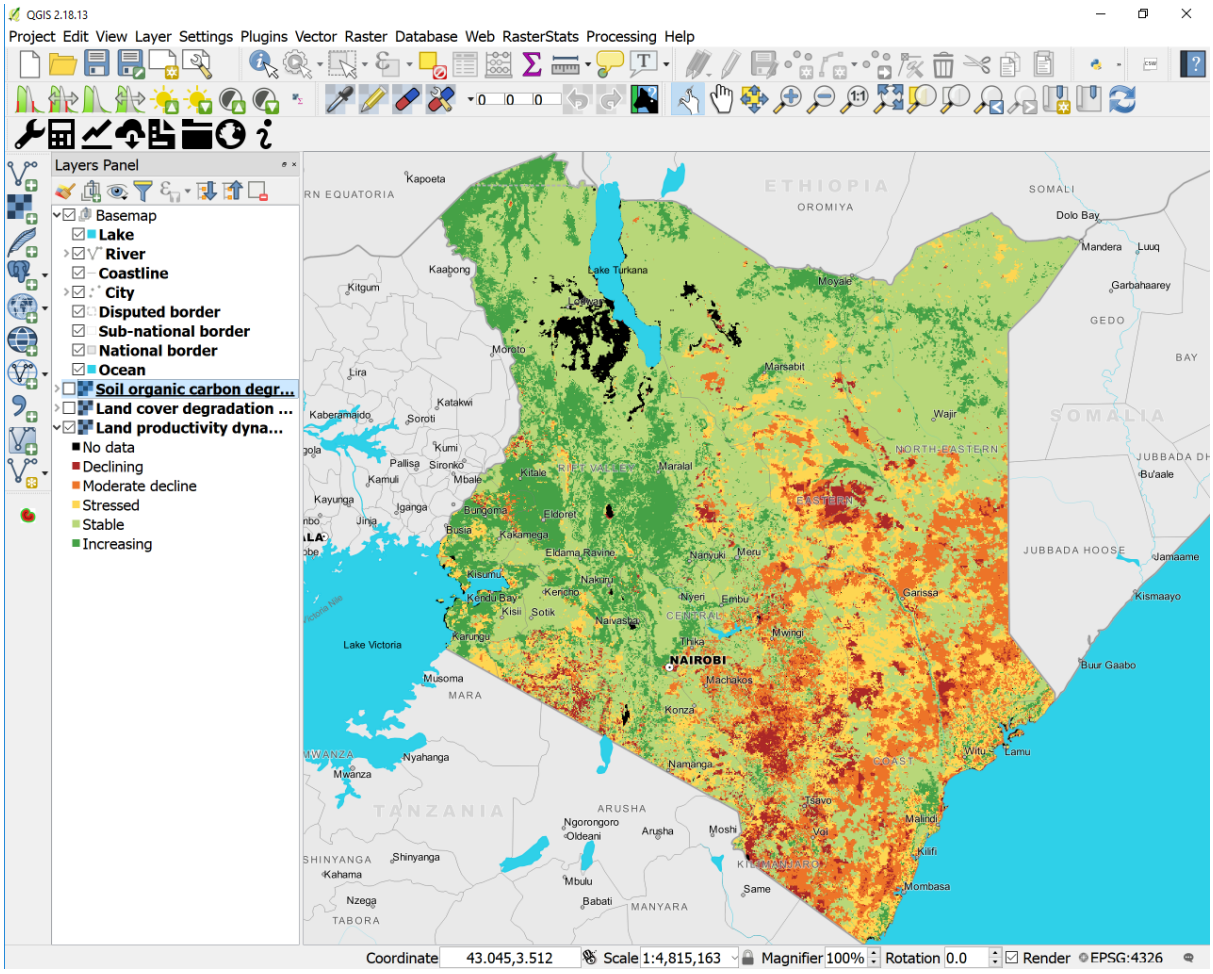
Here there are two options: "Add Basemap" or "Create Print Map". The first allows users to add a Basemap for a first or second level administrative boundary. The second option brings up the Composer window in QGIS to design and export a static map.



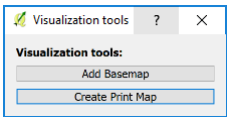
By selecting "Add Basemap", the user can select the first or second level administrative boundary. The first level is the country boundary. The second level will be the first sub-division that the country is divided into and will be dependent on the country selected. For example, in the United States of America, the second level will provide a drop down of states. In Kenya, the second level will display provinces. Please note the disclaimer in the window. Natural Earth provides the spatial layers contained within the dropdown. These boundaries are not official endorsed by CI or other partner organizations and contributors. After selecting the dropdown, for the first level and second level if applicable, select "Ok".



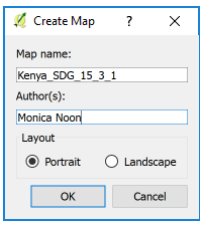
After submitting the above message will appear within the QGIS Desktop window. This shows that the Basemap is loading. DO NOT select cancel or attempt another function in QGIS until the Basemap has loaded. The time it takes to load will depend on your Internet connection and computer processor.



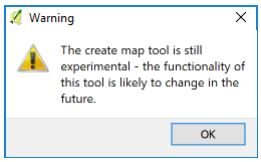
If you have a map layer within your QGIS Desktop window, you will now see the Basemap with the administrative level selected clipped out to view the underlying map layer. If you would like to export to an image or PDF, select the report icon (). This will open up the "Visualization tools" dialog box:



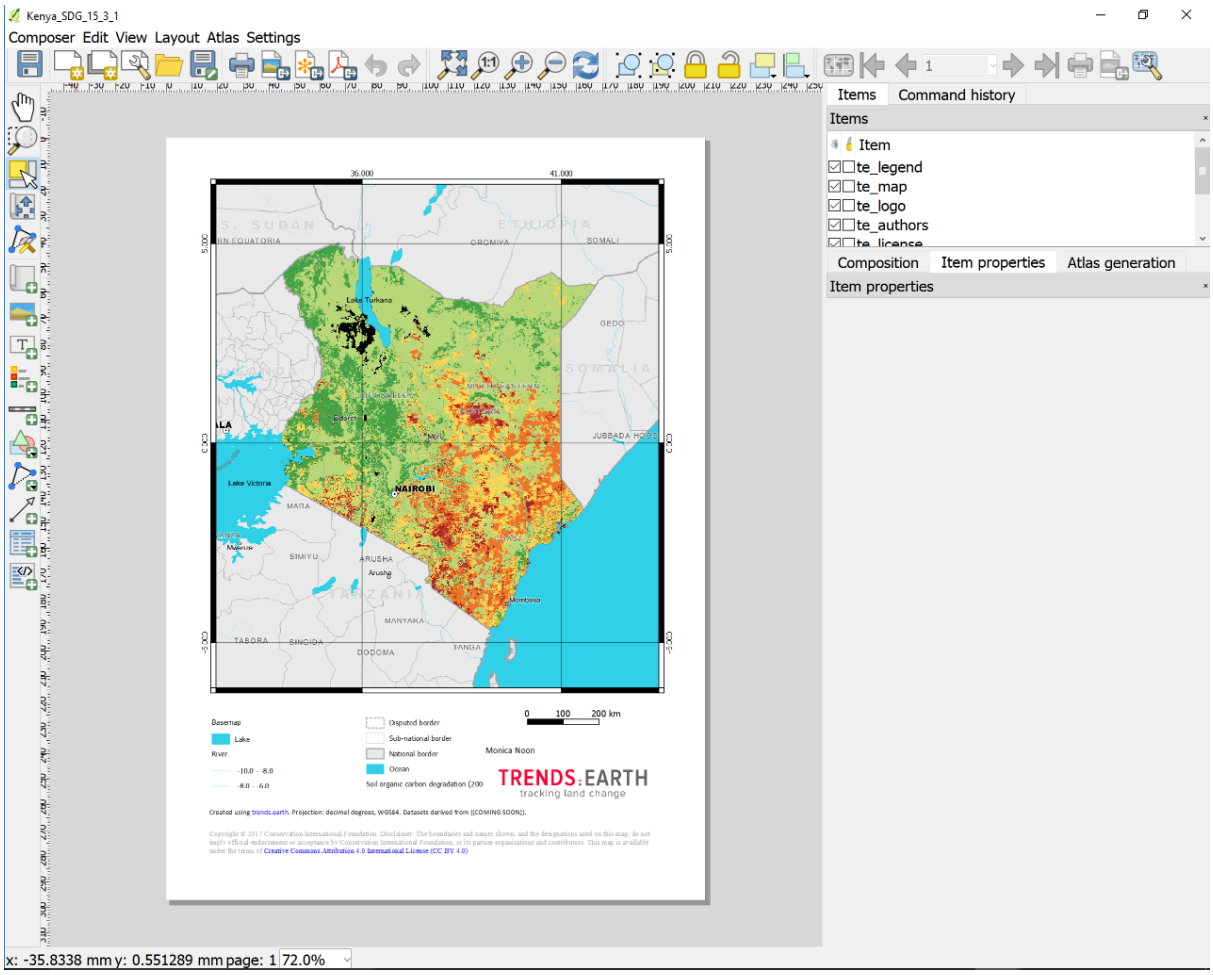
Enter the title for the map and author(s). Select Portrait or Landscape. Portrait is ideal for boundaries that are longer in height than width, landscape is ideal for boundaries that are longer in width than height.



A notification may appear. Select "Ok" after reading to close the window.

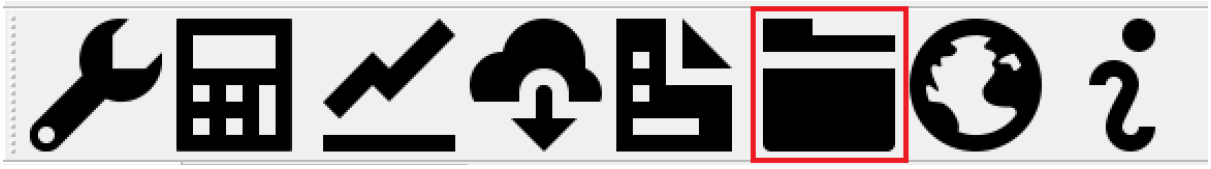


The Map Composer in QGIS will appear. This allows the user to design a map for export as image (.png or .jpg) or PDF. The user has the ability to change the appearance of the legend and the arrangements of features in the map. The map layer within the QGIS Desktop window will appear within the Composer. Underneath the Settings menu options, there are several icons to export.



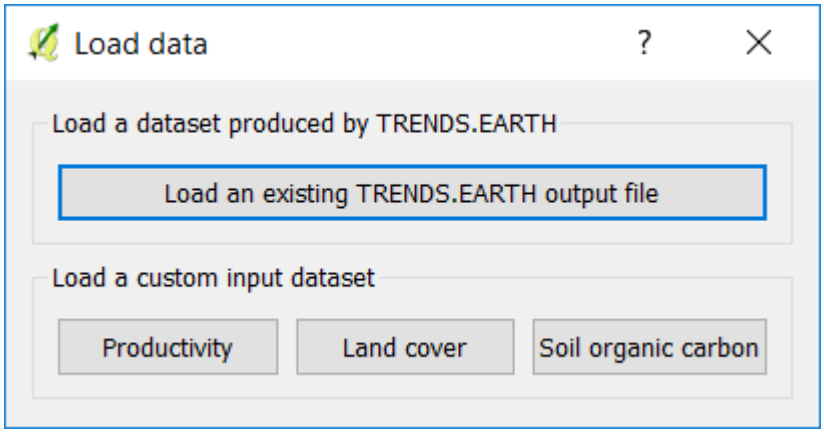
CHAPTER 14

Load data tool



The “Load data” function allows the user to load data into QGIS and TRENDS.EARTH for analysis.

There are two options, to load results of TRENDS.EARTH analysis or to load custom datasets which will be used to compute the indicators.



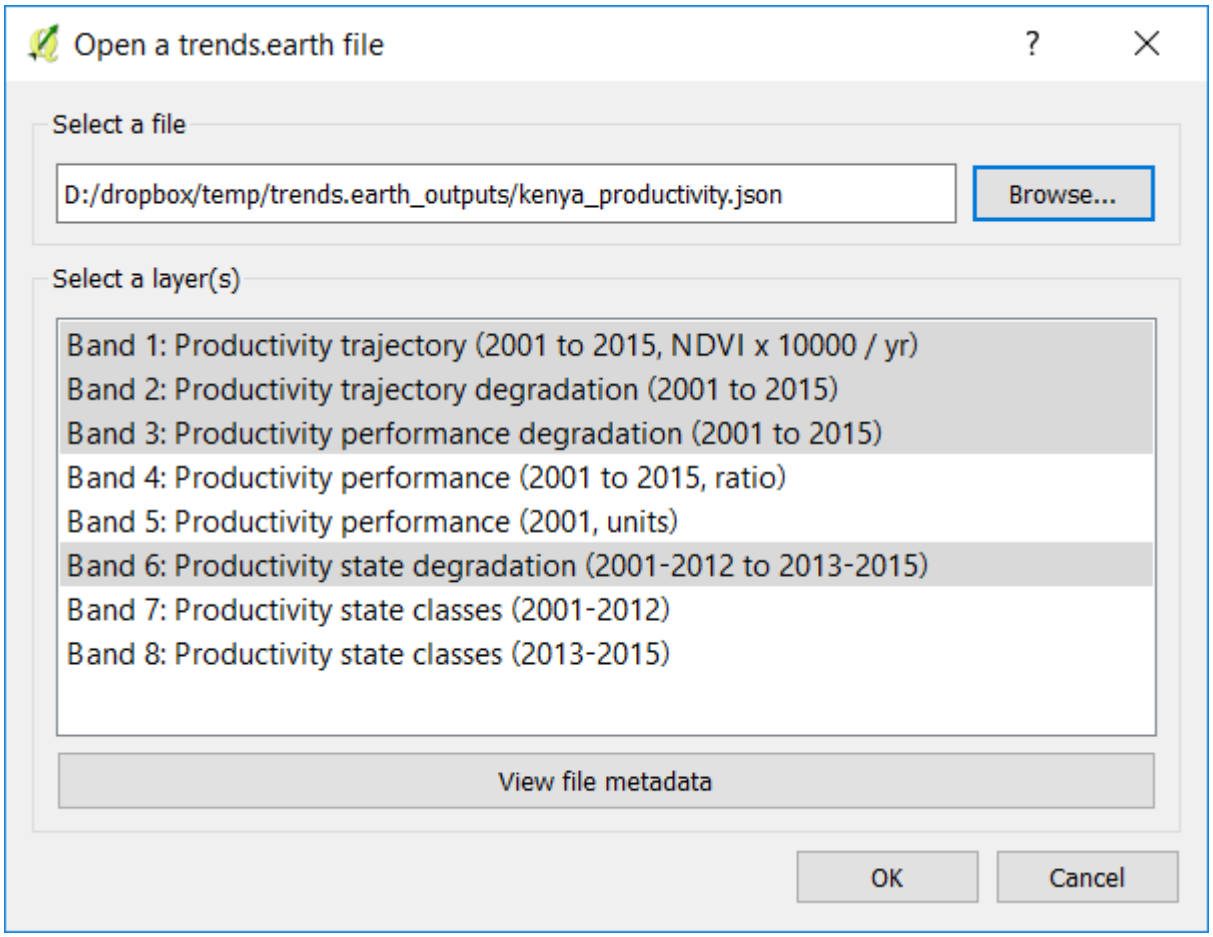
14.1 Load a dataset produced by Trends.Earth

This option lets you load already downloaded results from TRENDS.EARTH.

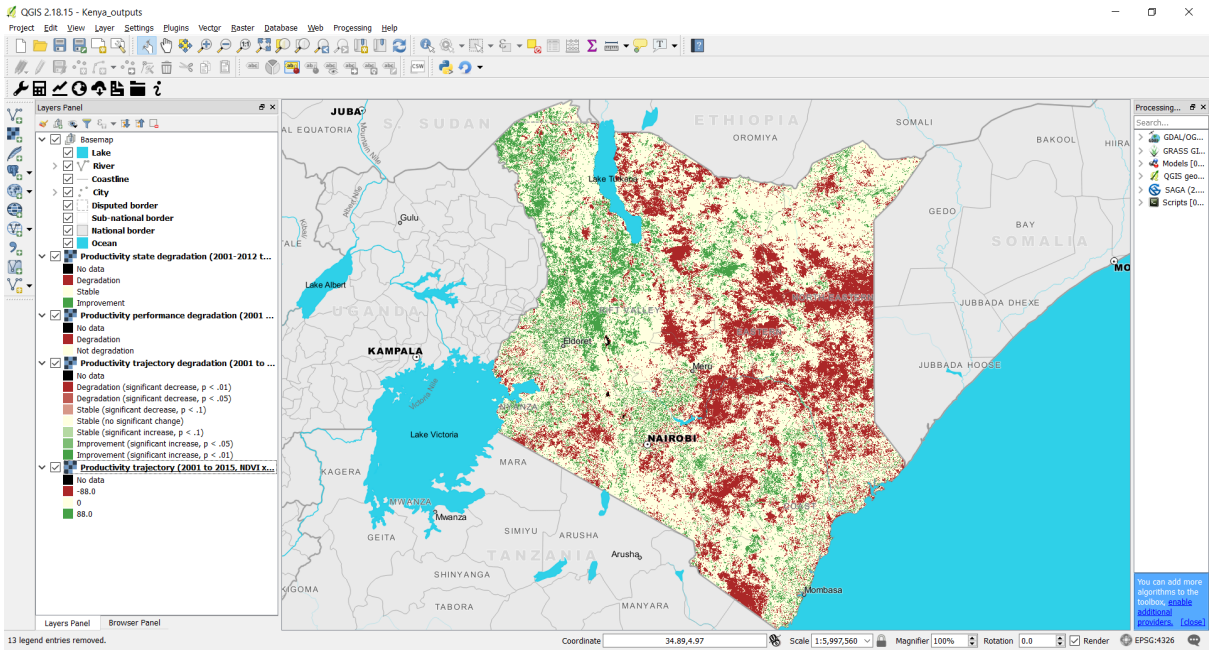
14.1.1 Productivity

Use this function to load into the QGIS map pre-computed productivity indicators which had been processed to identify land degradation.

Navigate to the folder where you stored the downloaded file and select it. The downloaded file is an 8 band raster, with each band representing the three subindicators (trajectory, performance and state) plus other information which may help you interpret the trends identified. The layers to be loaded into the QGIS maps are the ones highlighted in gray. By default: trajectory (degradation and slope), performance and state. If you want to load the other layers, simply select them and click OK.



The layers will be loaded in the QGIS map with its corresponding symbology.

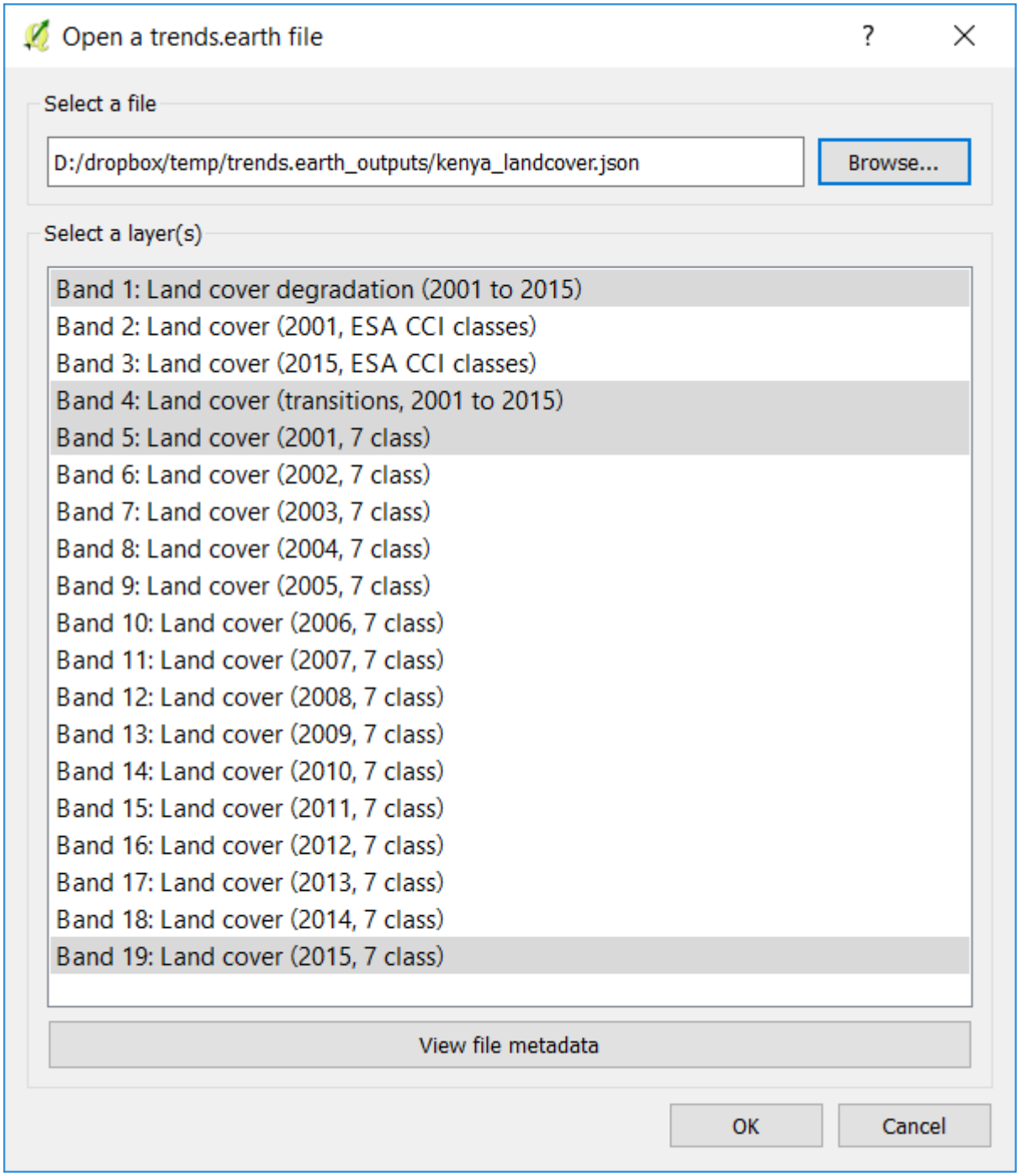


14.1.2 Land cover

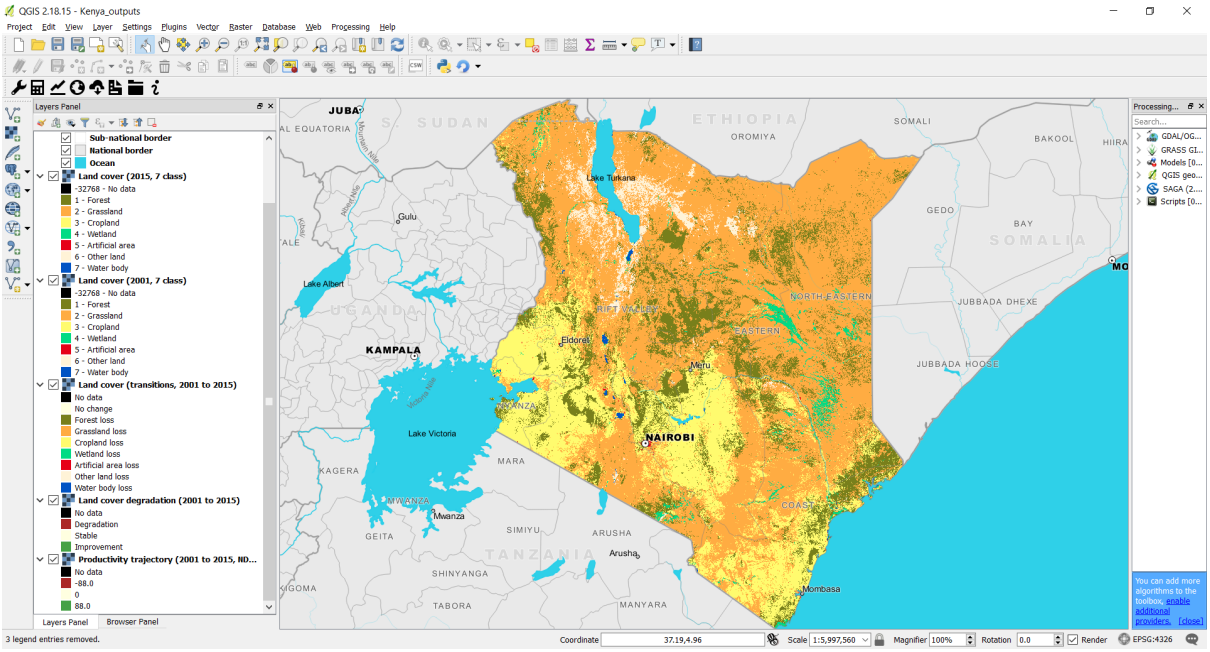
This option lets you load pre-computed land cover indicators which had been processed to identify land degradation.

Navigate to the folder where you stored the downloaded file and select it. The downloaded file is a multi band raster. The number of bands will depend on the period of analysis selected and the data source used. If the default ESA CCI land cover was used, for example, annual land cover maps will be downloaded.

The bands in the stack represent: initial and final land cover (annual if available) both in the original classification scheme and using the UNCCD 7 class land cover table, land cover transitions and land cover degradation as identified by this subindicator. If you want to load the other layers not selected by default, simply select them and click OK.



The layers will be loaded in the QGIS map with its corresponding symbology.

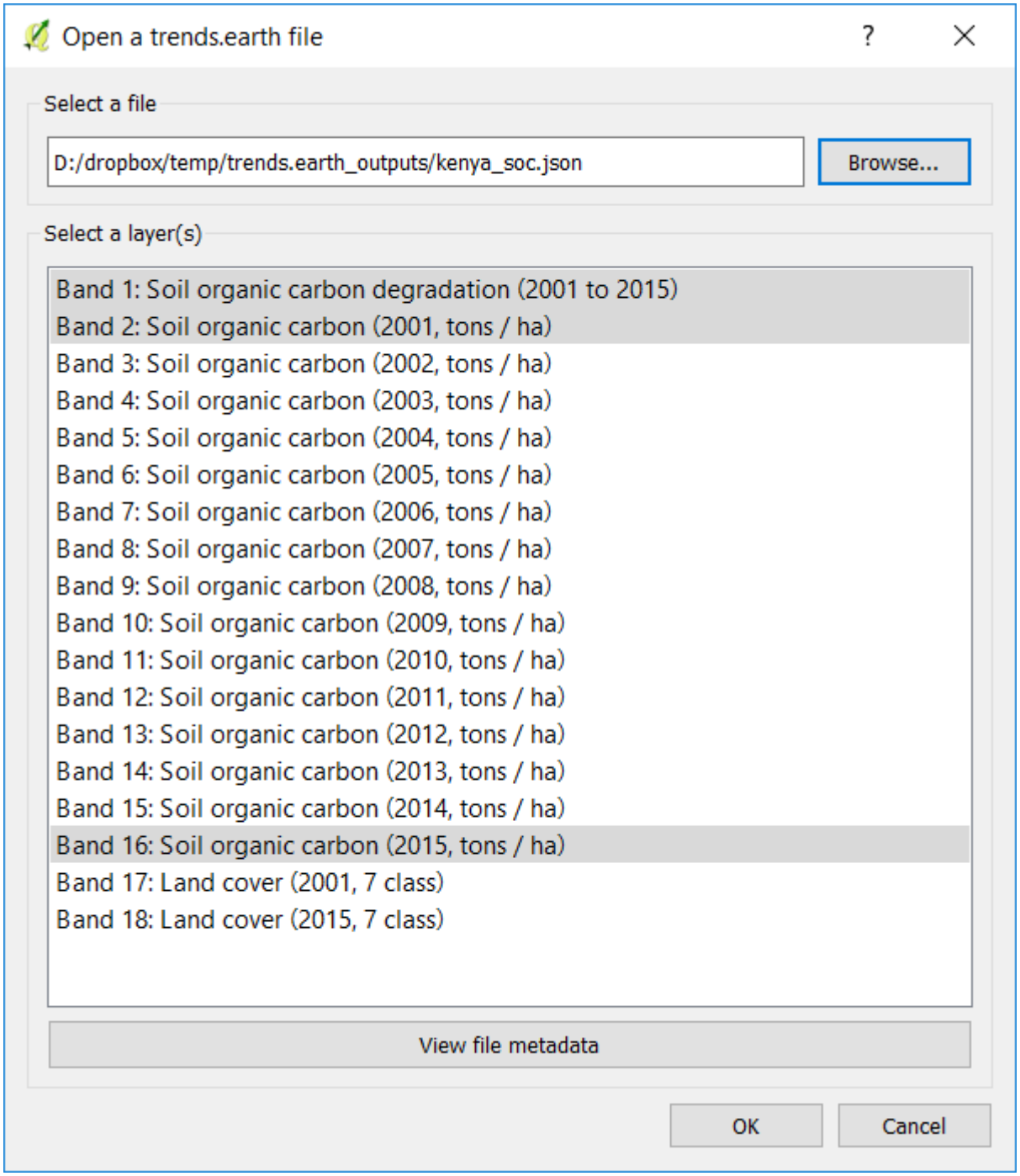


14.1.3 Soil organic carbon

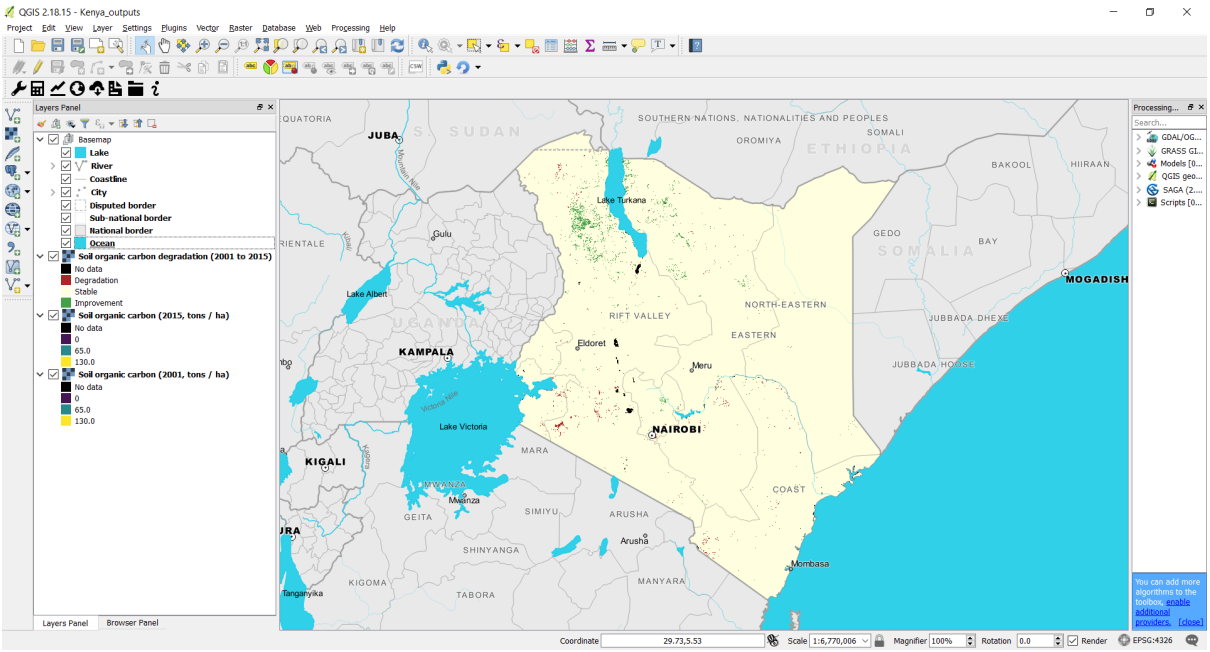
This option lets you load pre-computed soil organic carbon indicators which had been processed to identify land degradation.

Navigate to the folder where you stored the downloaded file and select it. The downloaded file is a multi band raster. The number of bands will depend on the period of analysis selected and the data source used. If the default ESA CCI land cover was used, for example, annual soil organic carbon maps will be downloaded.

The bands in the stack represent: initial and final soil organic carbon stocks (annual soc if annual land data is available), initial and final land cover maps using the UNCCD 7 class land cover classification,and degradation as identified by this subindicator. The units of the degradation layer are "% change", if changes are larger than 10% for the period, they will be considered as improvement or degradation depending on the sign of the change. If you want to load the other layers not selected by default, simply select them and click OK.



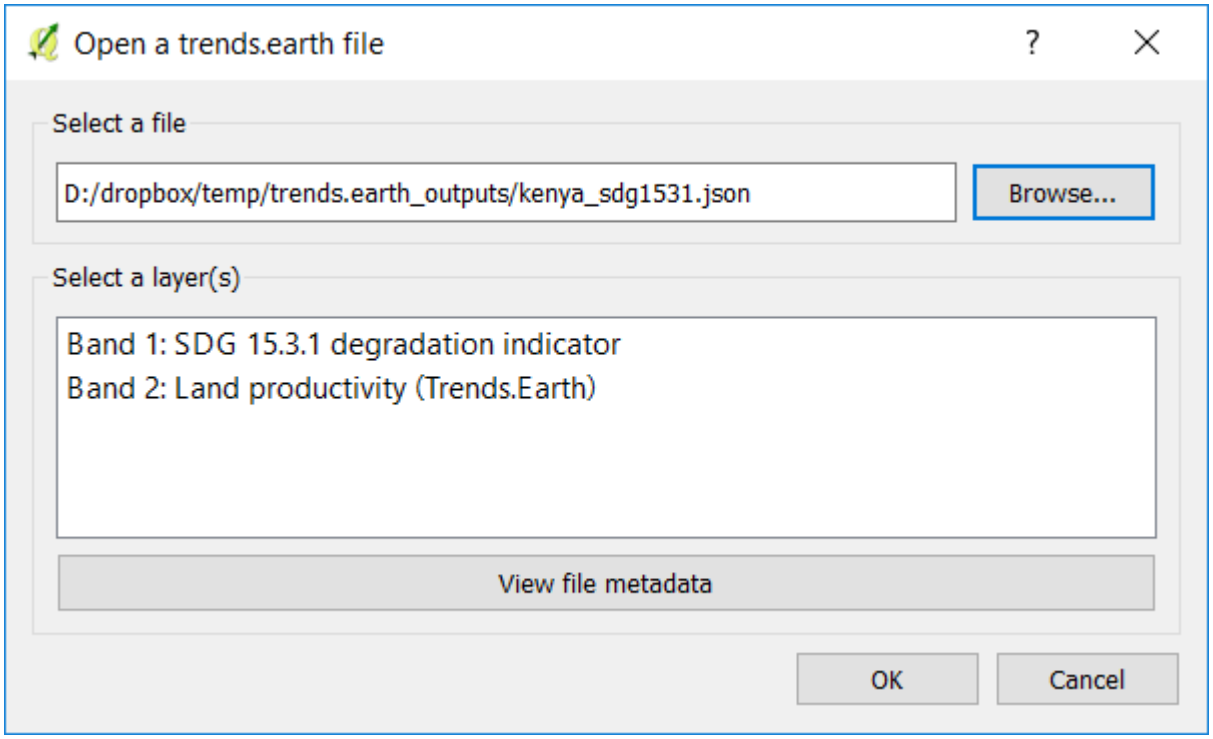
The layers will be loaded in the QGIS map with its corresponding symbology.



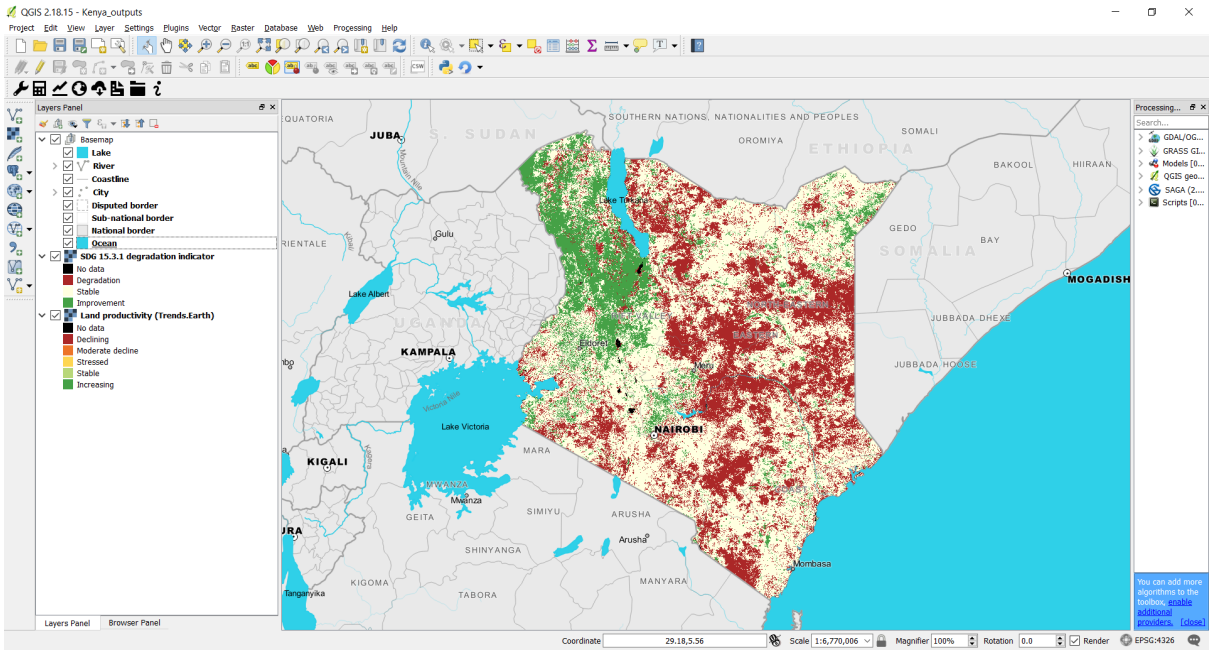
14.1.4 SDG 15.3.1 indicator

This option lets you load pre-computed productivity subindicator (the integration of trajectory, performance and state) as well as the final SDG 15.3.1 (the integration of productivity, land cover and soil organic carbon)

Navigate to the folder where you stored the downloaded file and select it. The downloaded file is an 2 band raster, the first one containing information on the SDG and the second on the 5 classes productivity subindicator.



The layers will be loaded in the QGIS map with its corresponding symbology.



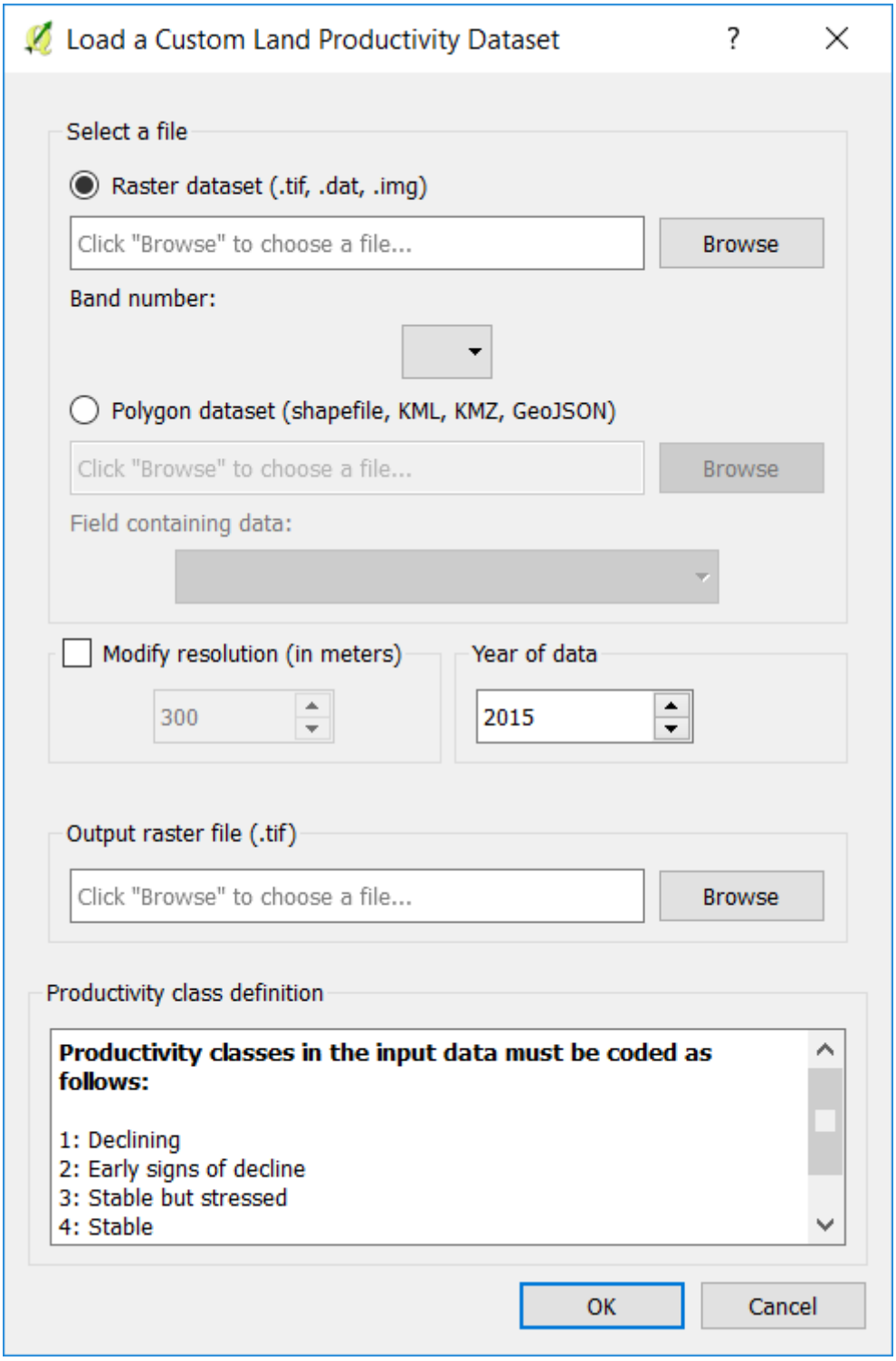
14.2 Load a custom input dataset

14.2.1 Productivity

Use this option to load productivity datasets which have already been generated outside of TRENDS.EARTH.

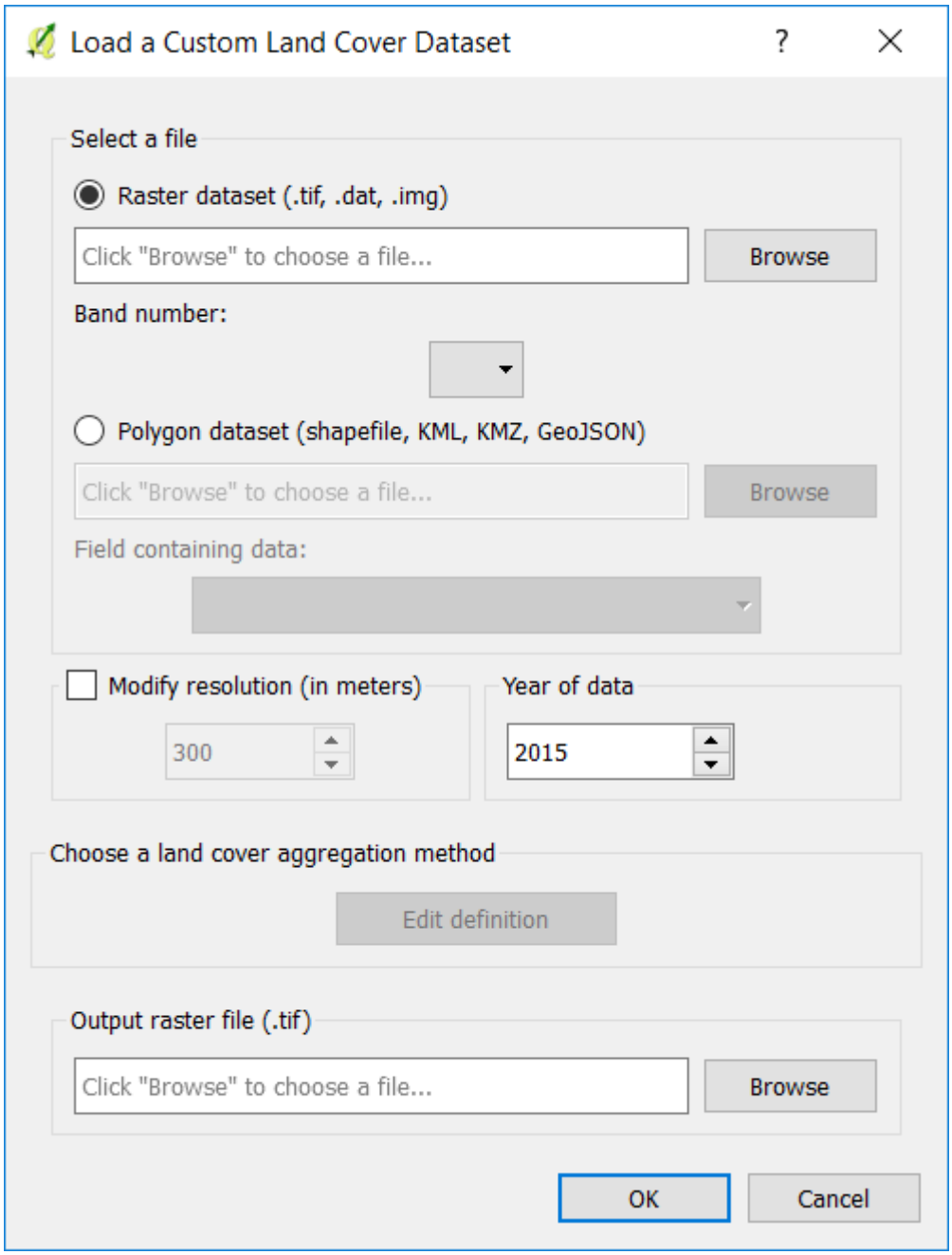
Productivity classes in the input data must be coded as follows:

1: Declining 2: Early signs of decline 3: Stable but stressed 4: Stable 5: Increasing 0 or -32768: No data



14.2.2 Land cover

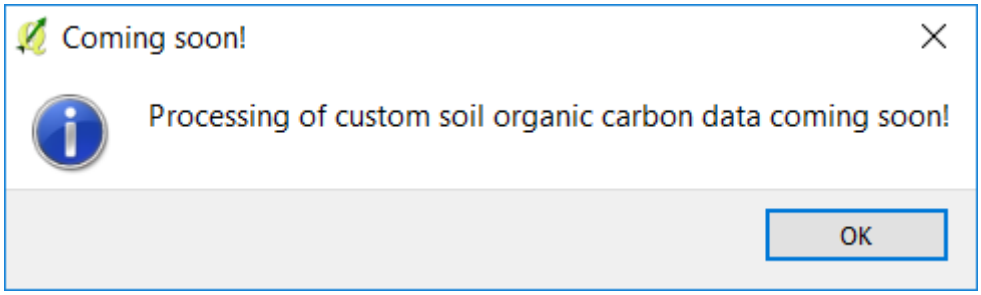
Use this option to load land cover datasets which will then be used for land cover change analysis and/or soil organic carbon change analysis.



Note: If you'll be using the CORINE land cover data, you can use this definition file to pre-load a suggested aggregation of the land cover classes in Corine to convert them to the 7 UNCCD land cover classes.

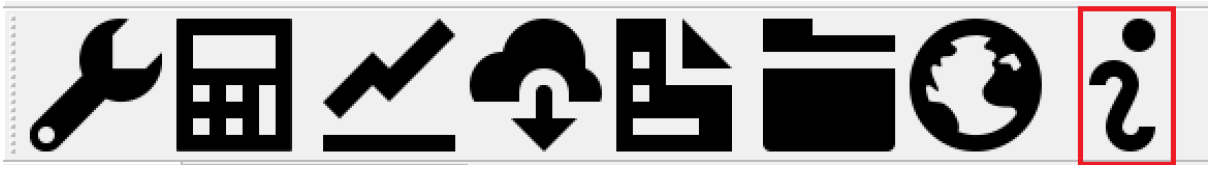
14.2.3 Soil organic carbon

Processing of custom soil organic carbon data will be available soon.

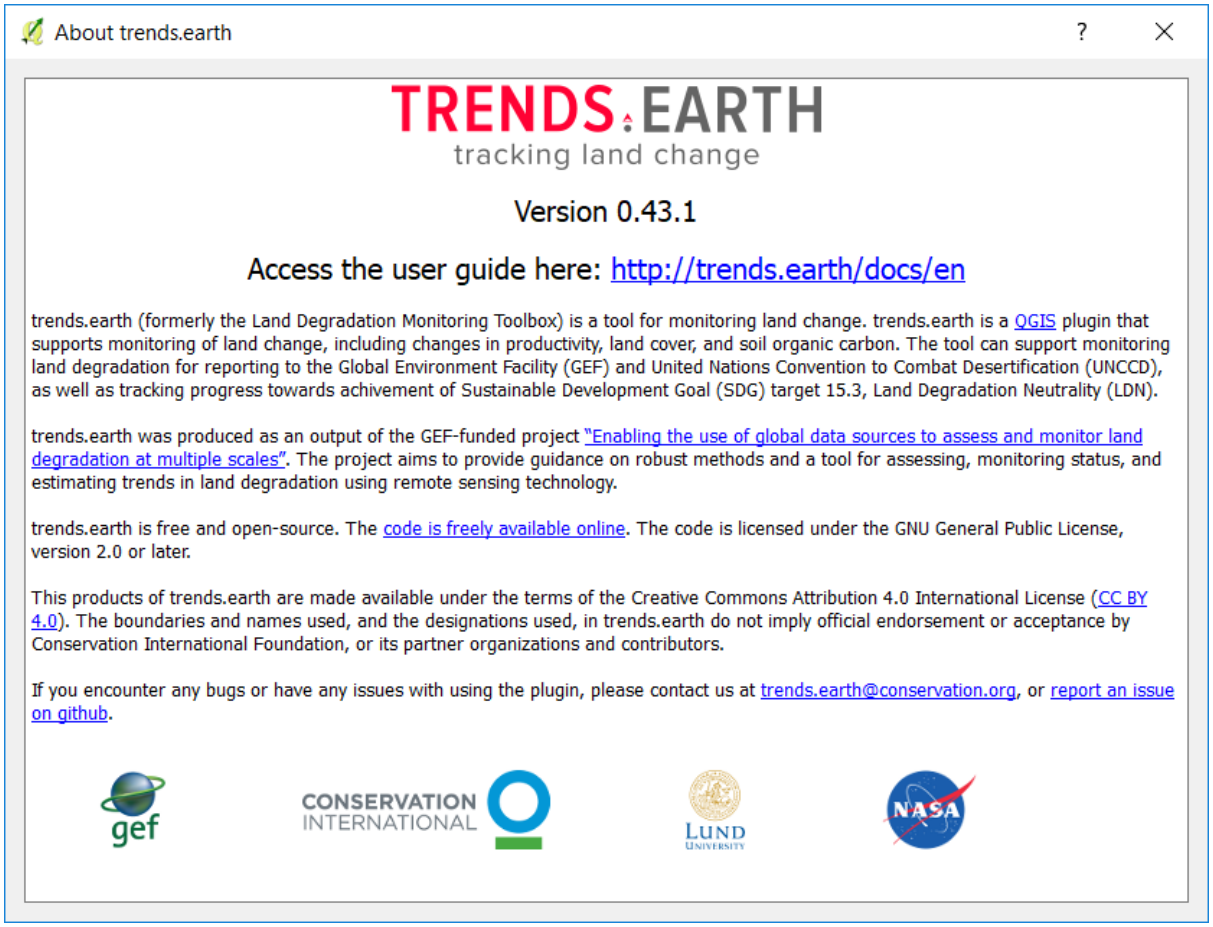

Coming soon!
Processing of custom soil organic carbon data coming soon!
OK

CHAPTER 15

About



The about page lists background information on the development of TRENDS.EARTH, and indicates the version of the tool that is installed.


About trends.earth
TRENDS.EARTH
tracking land change
Version 0.43.1
Access the user guide here: http://trends.earth/docs/en
trends.earth (formerly the Land Degradation Monitoring Toolbox) is a tool for monitoring land change. trends.earth is a QGIS plugin that supports monitoring of land change, including changes in productivity, land cover, and soil organic carbon. The tool can support monitoring land degradation for reporting to the Global Environment Facility (GEF) and United Nations Convention to Combat Desertification (UNCCD), as well as tracking progress towards achivement of Sustainable Development Goal (SDG) target 15.3, Land Degradation Neutrality (LDN).
trends.earth was produced as an output of the GEF-funded project "Enabling the use of global data sources to assess and monitor land degradation at multiple scales". The project aims to provide guidance on robust methods and a tool for assessing, monitoring status, and estimating trends in land degradation using remote sensing technology.
trends.earth is free and open-source. The code is freely available online. The code is licensed under the GNU General Public License, version 2.0 or later.
This products of trends.earth are made available under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0). The boundaries and names used, and the designations used, in trends.earth do not imply official endorsement or acceptance by Conservation International Foundation, or its partner organizations and contributors.
If you encounter any bugs or have any issues with using the plugin, please contact us at trends.earth@conservation.org, or report an issue on github.
gef
CONSERVATION INTERNATIONAL
LUND UNIVERSITY
NASA

Part IV

Step-by-step guides

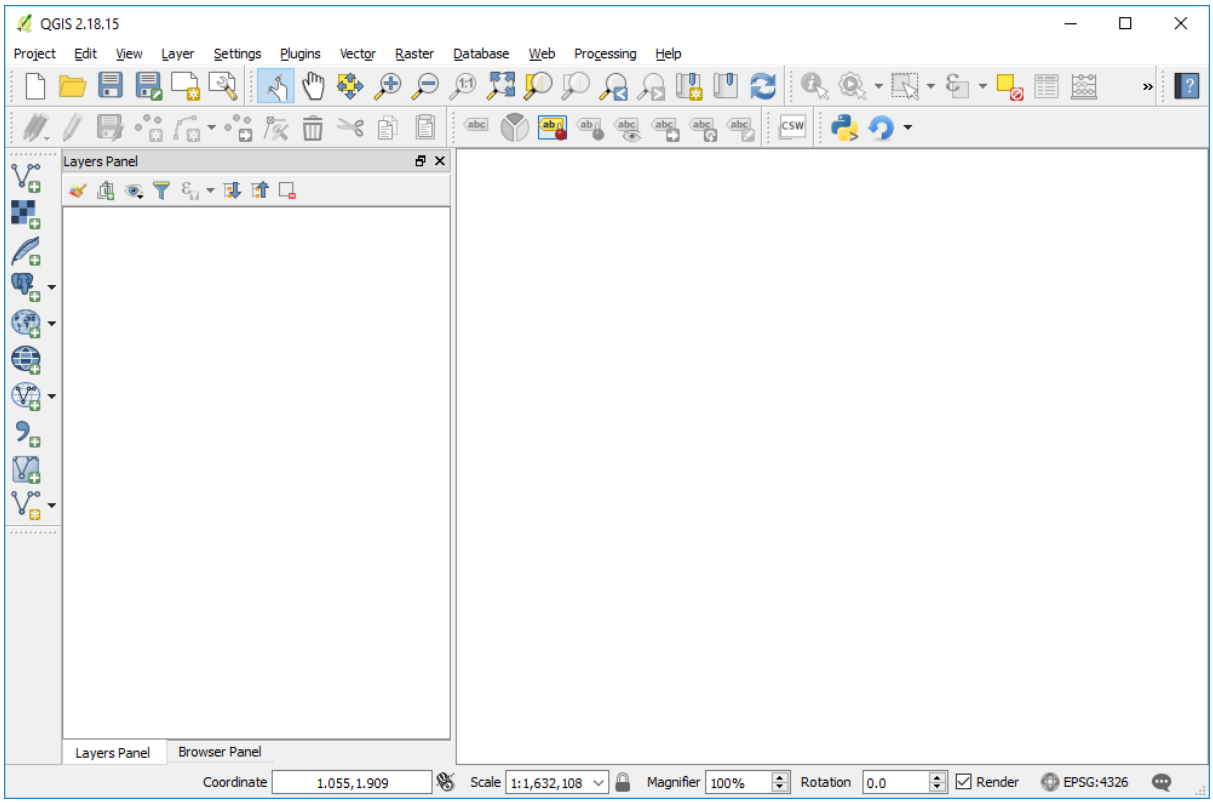
CHAPTER 16

Installation and Registration

- Objective: Learn how to install, register and login to use the Trends.Earth plugin in QGIS. These step needs to be completed only the first time you use the tool. Your user will be then saved for future sessions.
- Estimated time of completion: 20 minutes
- Internet access: Required

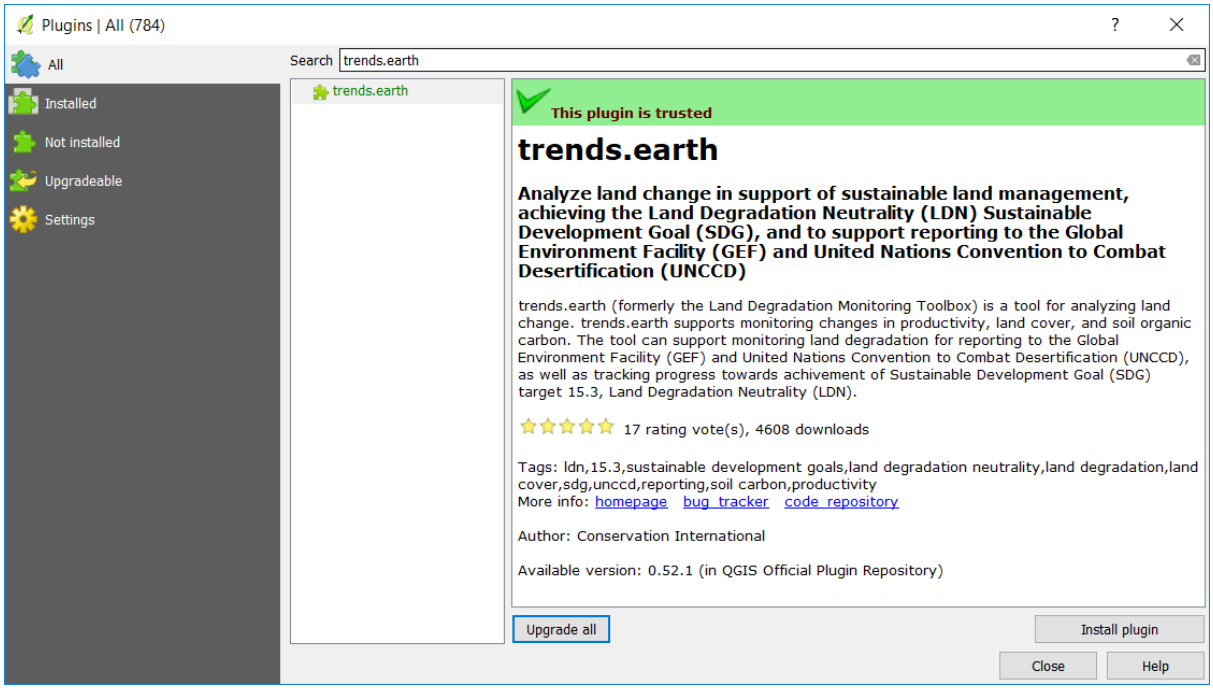
Note: Download this page as a PDF for offline use

1. Once QGIS is installed open it by searching in the for the QGIS icon on your computer's desktop or program menu.
2. Once QGIS loads, search in the menu bar for Plugins. Click and a drop down menu will open.
3. Click on Manage and Install plugins. The Plugins window will open.

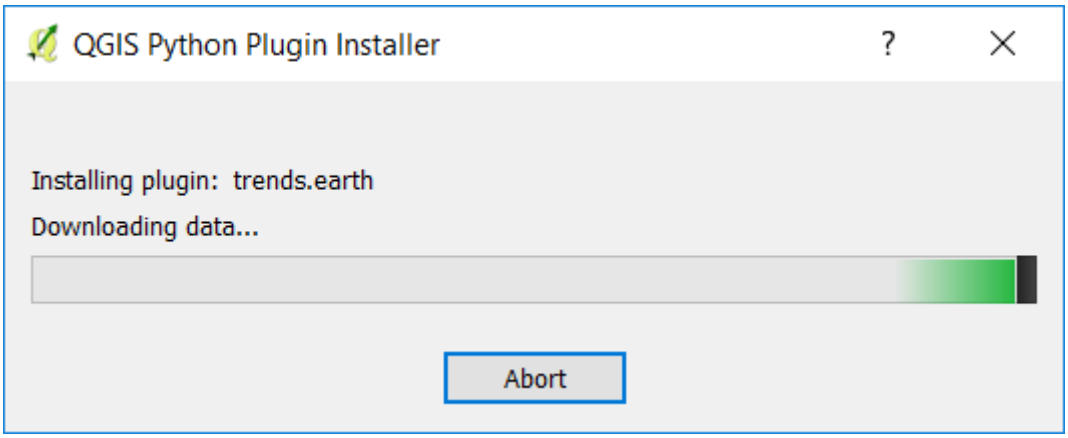


4. In the search window type Trends.Earth.

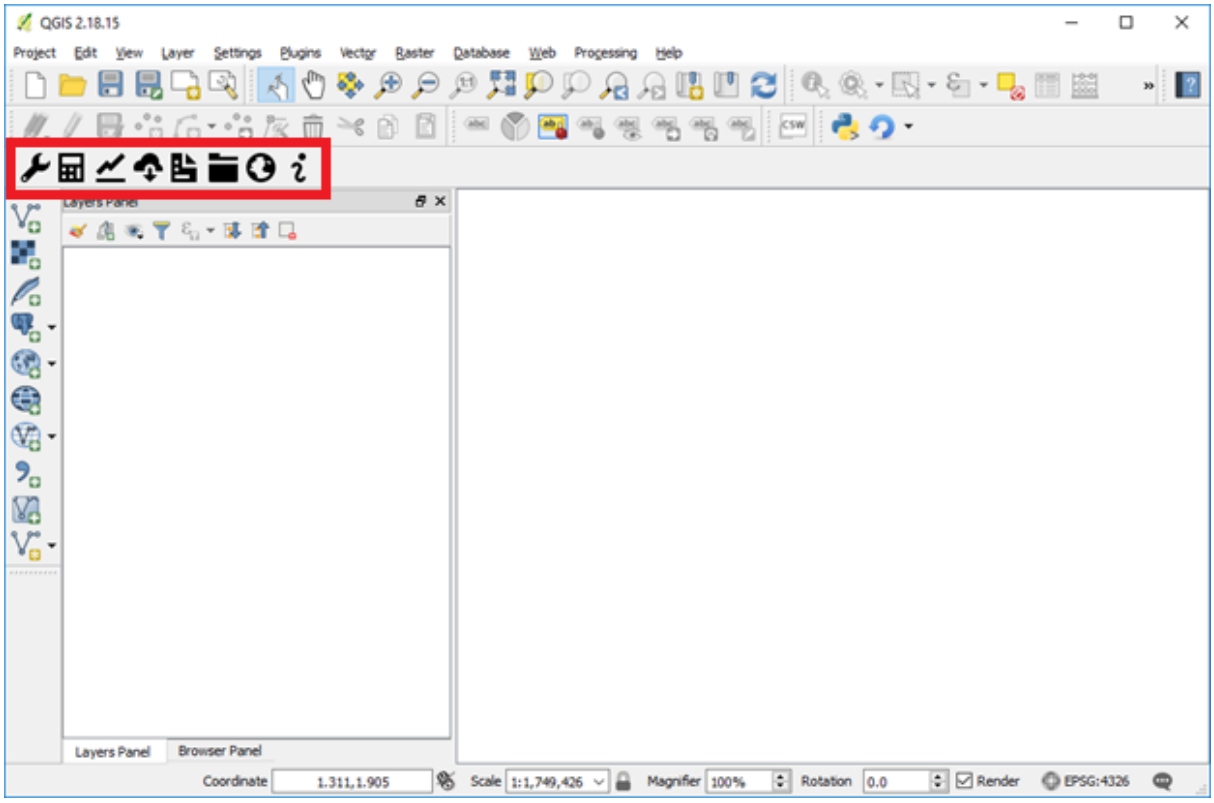
5. Click on the Trends.Earth plugin icon in the middle window and information on the toolbox will be displayed in the panel to the right.



6. To install the plugin click Install plugin button located in the bottom right section of the window. A small window will pop-up showing the progress bar for the download and installation of the Trends.Earth plugin. This process could take a few minutes depending on the speed of the Internet connection and the computer you are using.



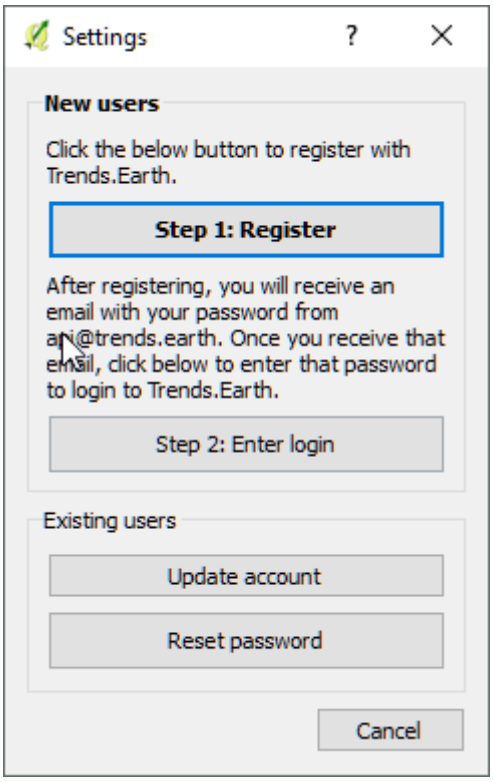
7. Once the window with the progress bar disappears click Close to close the Plugin Window. Trends.Earth will be installed in your computer. It will show in your QGIS tool bar as the series of icons highlighted below.



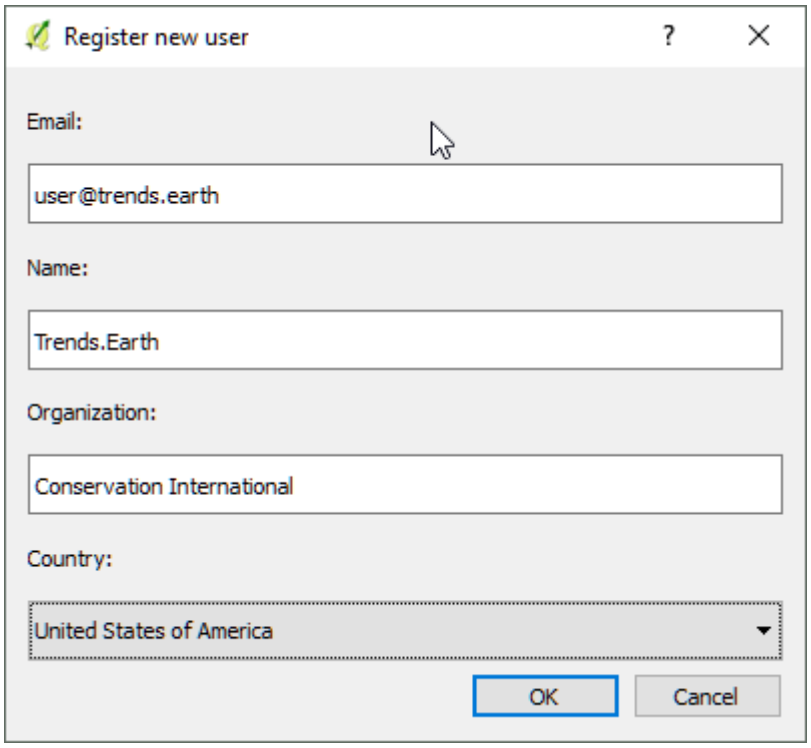
8. To create your account click on the wrench icon ().



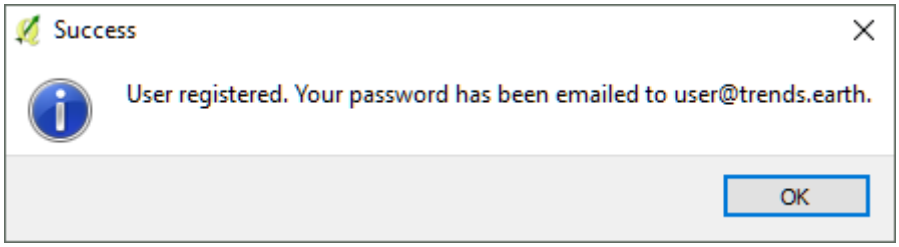
9. To Register, click the Step 1: Register button.



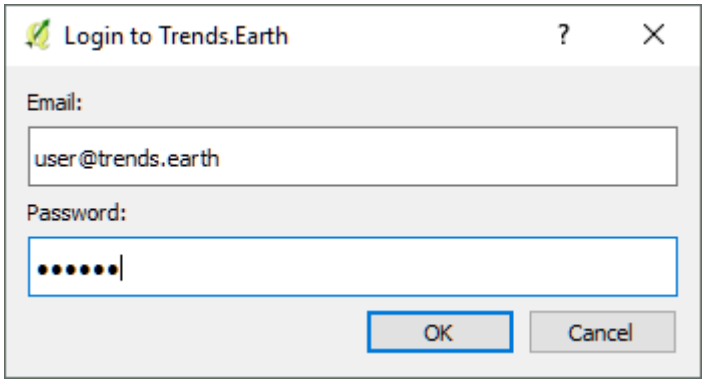
10. Enter your email, name, organization and country of residence.



11. Select Ok and you will see a message indicating your user has been registered.



12. After registering, you will receive an email from api@trends.earth with your password. If you don't see the email in your inbox after 15-20 seconds, please check your spam folder in case the email was sent there. Once you receive this email , click on Step 2: Enter login. This will bring up a dialog asking for your email and password. Enter your email address and the password you received from api@trends.earth and click Ok.



13. You will see a message indicating you have successfully been logged in:



You are now ready to start using Trends.Earth!

CHAPTER 17

Run 1-step subindicators

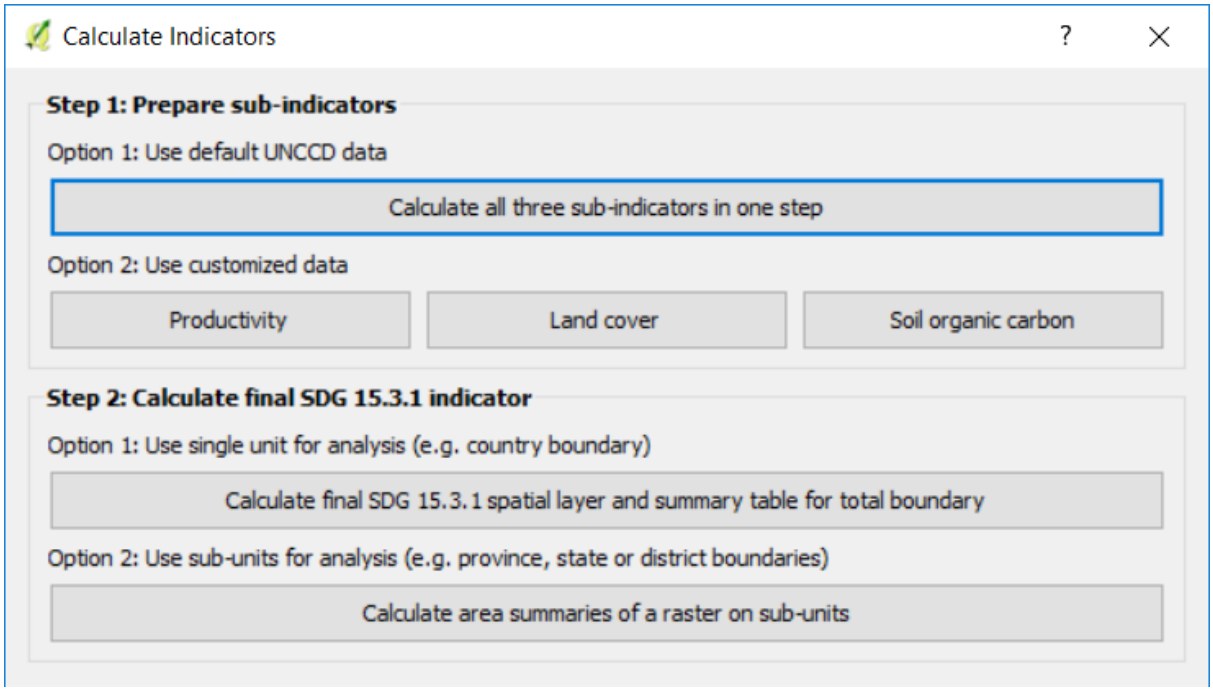
- Objective: Learn how to run SDG 15.3.1 sub-indicators (changes in land productivity, land cover and soil organic carbon) using Trends.Earth and the default data: LPD from JRC for land productivity, ESA CCI for land cover, and SoilGrids for soil organic carbon. In this tutorial we will use Uganda as an example, but you can choose any study area.
- Estimated time of completion: 30 minutes
- Internet access: Required

Note: Download this page as a PDF for off-line use

1. Search for the Trends.Earth toolbar within QGIS, and click on the Calculate icon ( ).

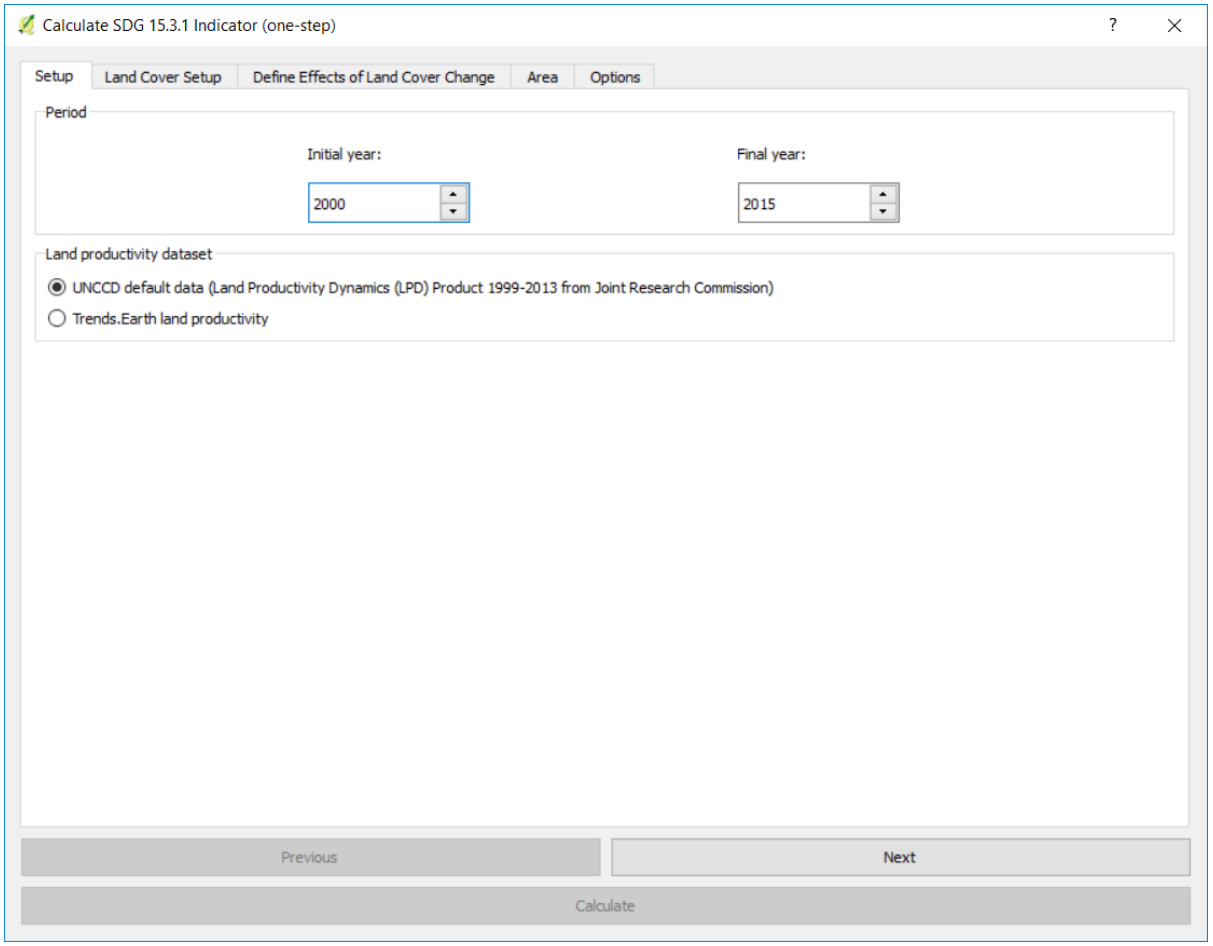


2. The Calculate Indicators menu will open. In that window, click on Calculate all three sub-indicators in one step button found under Step 1 - Option 1.

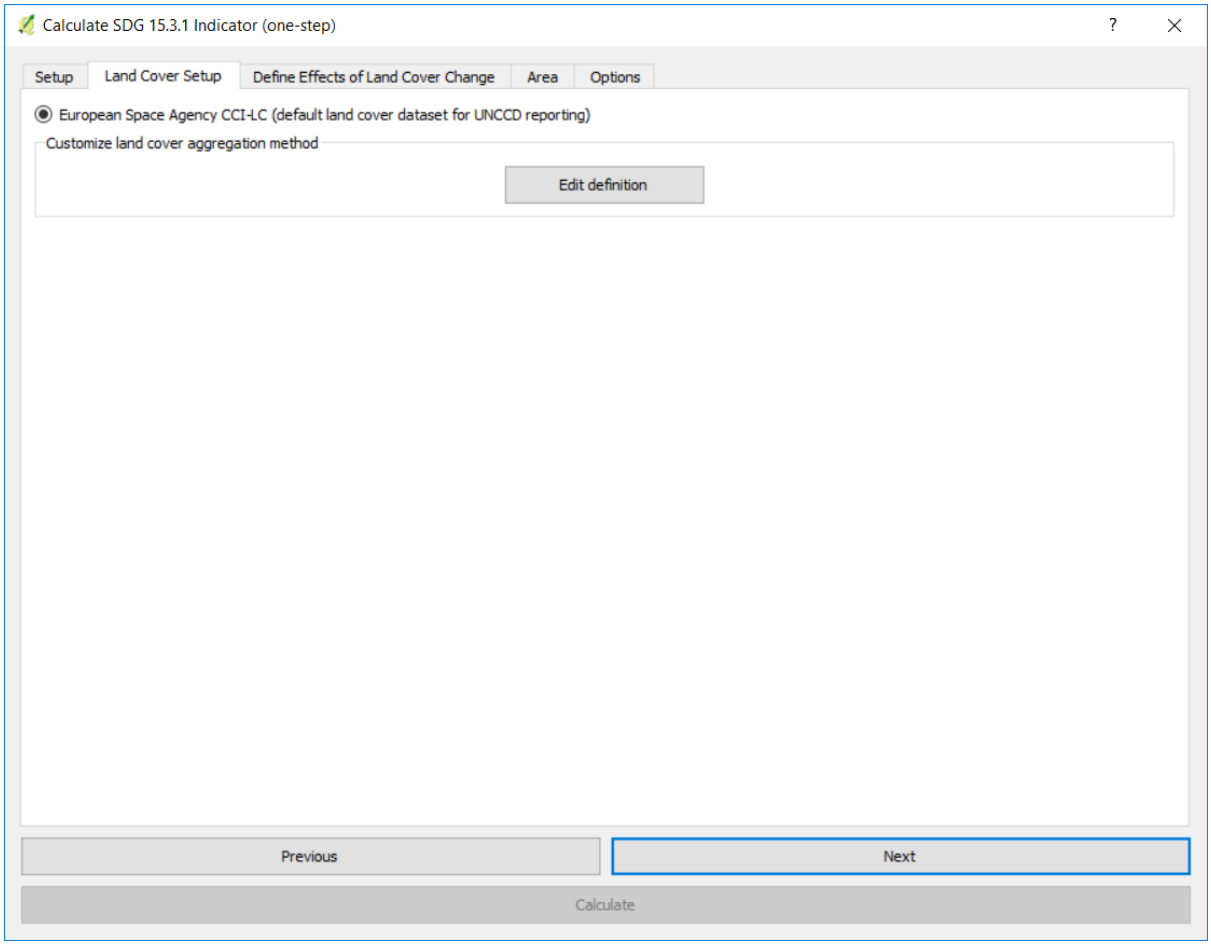


3. In the Setup tab, select the years of analysis (2000-2015) and make sure that the UNCCD default data is selected, and click next.

Note: Refer to the SDG Indicator 15.3.1 section of this manual to learn about the Trends.Earth productivity indicators developed following the UNCCD Good Practice Guidance (GPG).



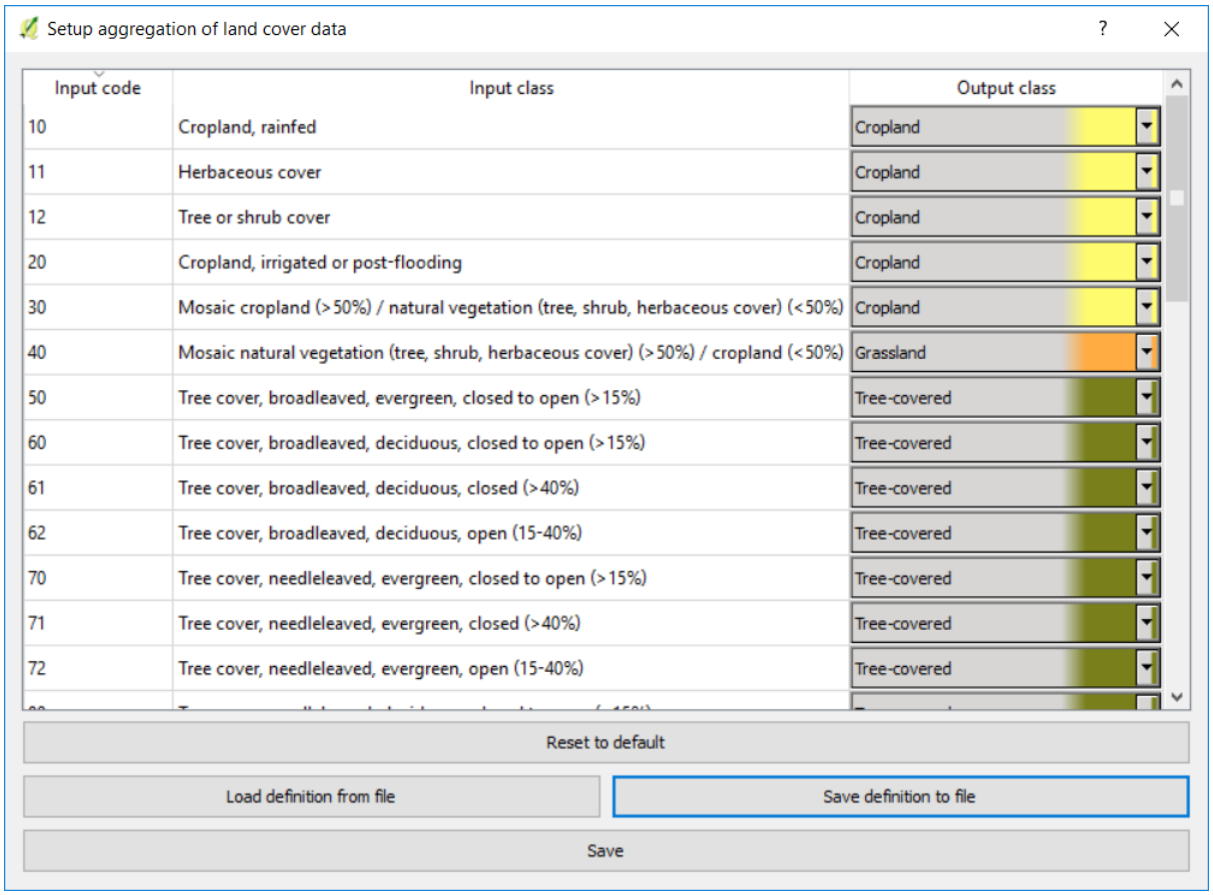
4. In the Land Cover Setup tab you have the option of using the default aggregation method proposed by the UNCCD default data or you can customize the aggregation of the legend from the original ESA CCI land cover classes to the 7 required for UNCCD reporting. To customize it, click on Edit definition and the Setup aggregation of land cover data window will open.



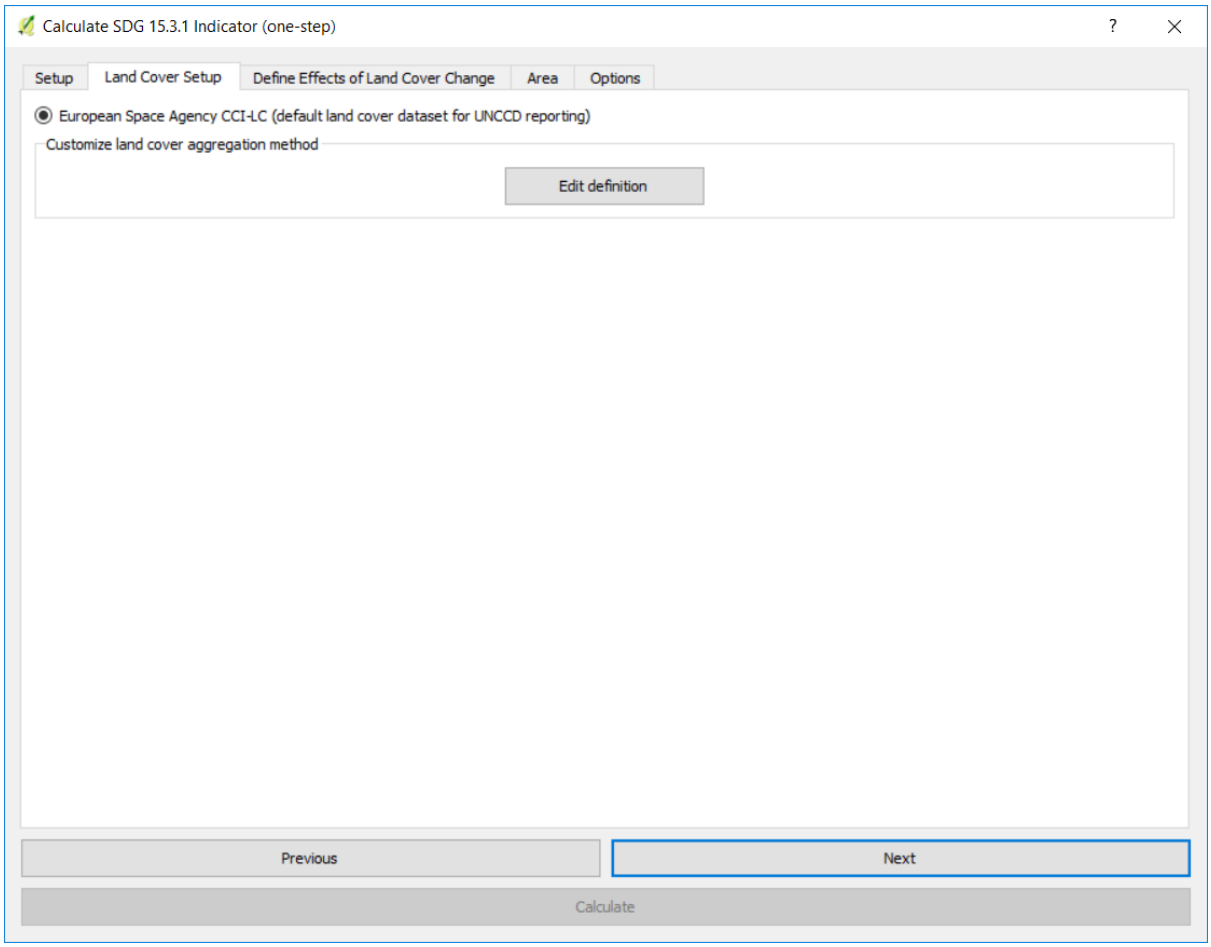
5. In this window you will see the original ESA CCI land cover class in the column Input class and the final aggregation in the column Output class. To change the output class simply click in the drop down arrow next to the color, and select the final output class you want the input class to be reassigned to. Note that this step is only needed if you consider that the default aggregation scheme does not represent the conditions of your study area.

   When you are done editing, click Save definition file. This option will save you time next time you run the tool, by simply loading the definition file you previously saved.

   Click Save to continue



6. You will be back at the Land Cover Setup tab, click Next.

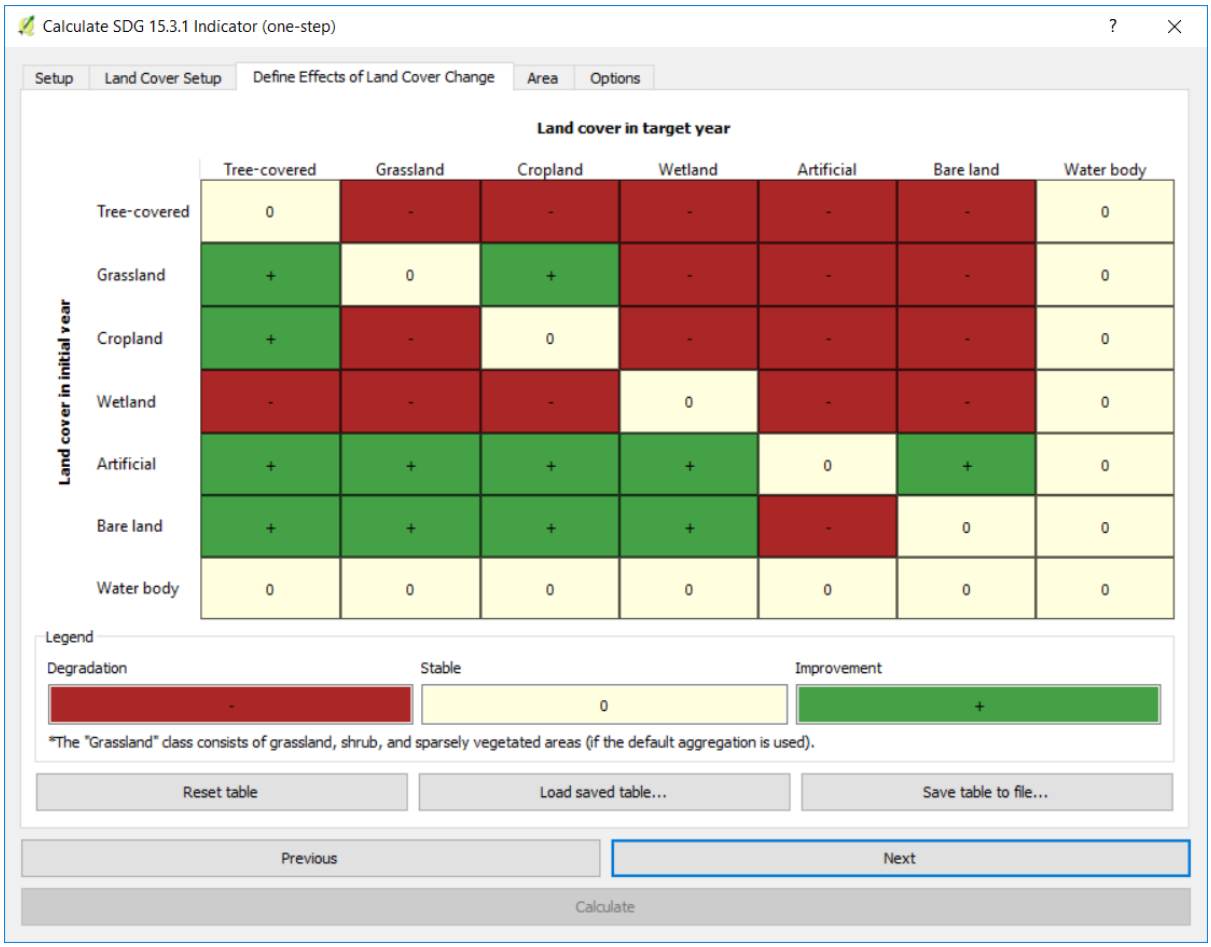


7. The Define Effects of Land Cover Change tab is where you define the meaning of each land cover transition in terms of degradation. Transitions indicated in red (minus sign) will be identified as degradation in the final output, transitions in beige (zero) will be identified as stable, and transitions in green (plus sign) will be identified as improvements.

   For example, by default it is considered that a pixel that changed from Grassland to Tree-covered will be considered as improved. However, if in your study area woody plant encroachment is a degradation process, that transition should be changed for that particular study area to degradation (minus sign).

   If you have made no changes to the default matrix, simply click Next.

   If you did change the meaning of some of the transitions, click on Save table to file… to save the definition for later use. Then click Next.



8. In the Area tab define the area of analysis. There are two options:

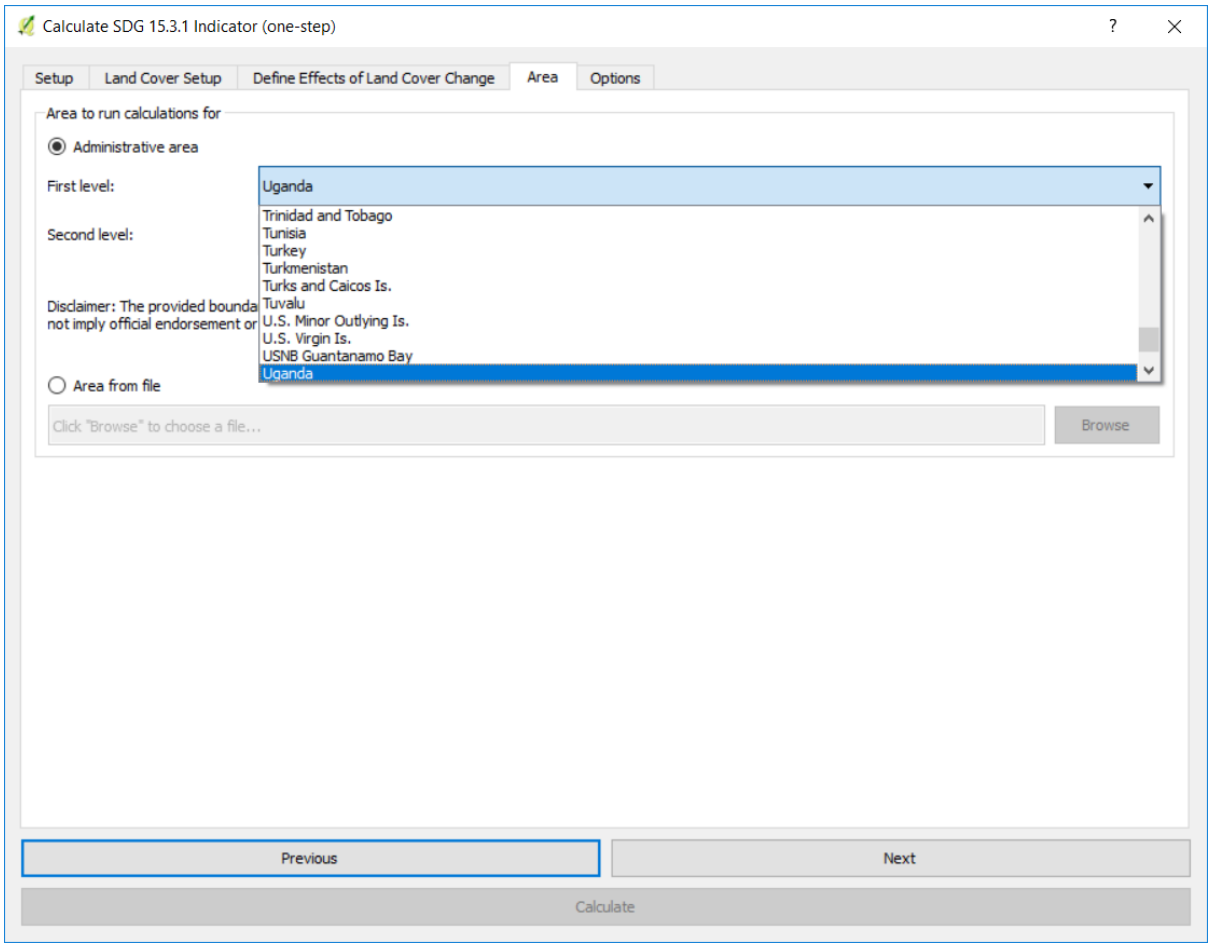
- Use provided country and state boundaries: If you want to use this option make sure the Administrative area option is highlighted, and then select the First Level (country) or Second Level (state or province depending on the country).

Note: The Natural Earth Administrative Boundaries provided in Trends.Earth, are in the public domain. The boundaries and names used, and the designations used, in Trends.Earth do not imply official endorsement or acceptance by Conservation International Foundation, or by its partner organizations and contributors.

If using Trends.Earth for official purposes, it is recommended that users choose an official boundary provided by the designated office of their country.

- Use your own area file: If you want to use your own area of analysis, make sure the Area from file option is highlighted. Then click Browse and navigate to the folder in your computer where you have the file stored.

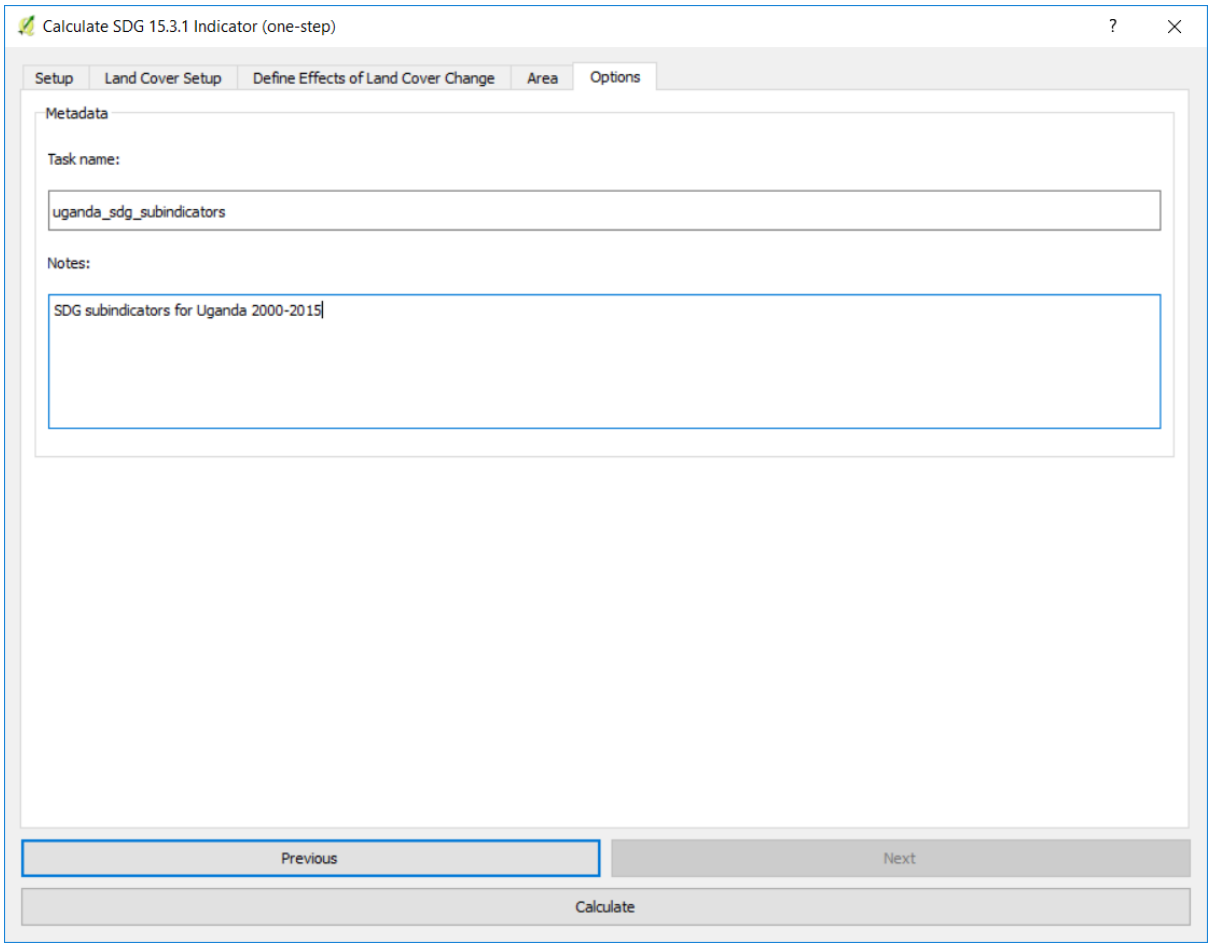
When you have selected the area for which you want to compute the indicators, click Next.



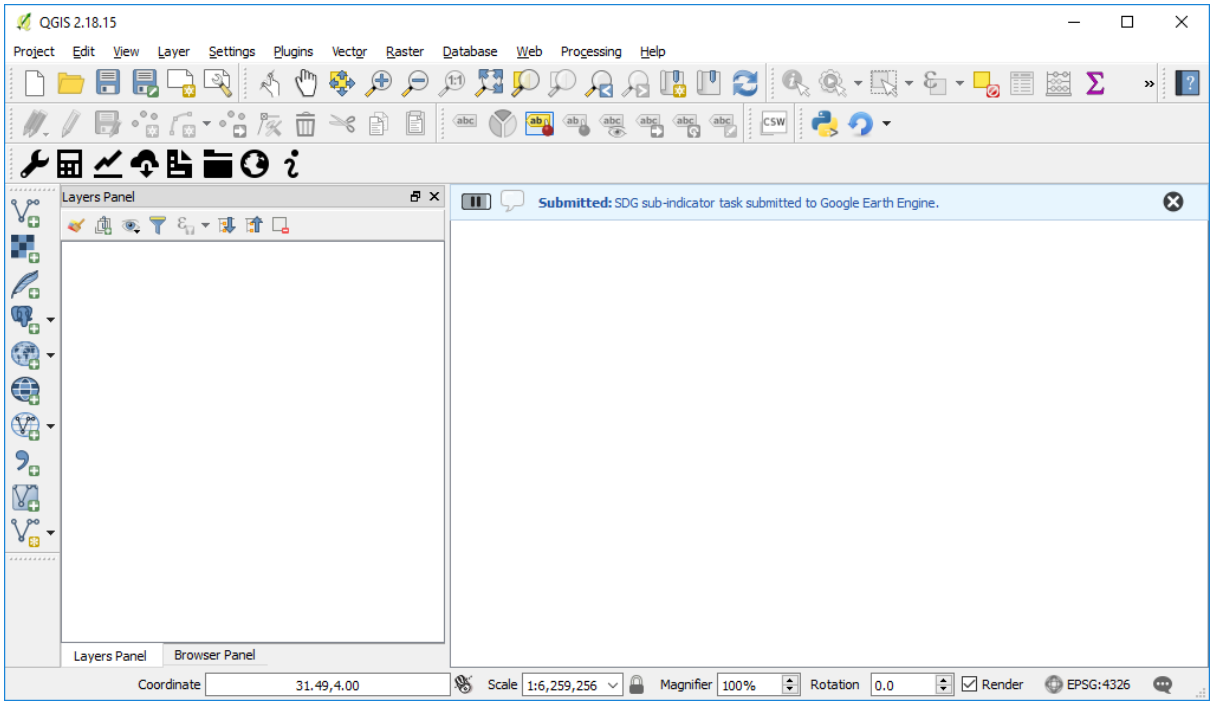
9. In the Options tab you can define the Task name and make some Notes to identify the analysis you are running. What information to indicate is optional, but we suggest noting:

- Area of analysis
- Dates
- Indicators run

10. When done, click Calculate and the task will be submitted to Google Earth Engine for calculations. You will notice that the Calculate SDG 15.3.1 indicator (one-step) window will disappear and you will be brought back to QGIS.



11. A light blue bar will temporarily show, indicating that the task was successfully submitted. The analysis will be run in Google servers and could take between 5 and 15 minutes depending on the size of the study area (larger areas tend to take longer).



Note: Refer to the Task status & download tutorial for instructions on how to check the status of the

tasks submitted and for downloading results from Trends.Earth.

CHAPTER 18

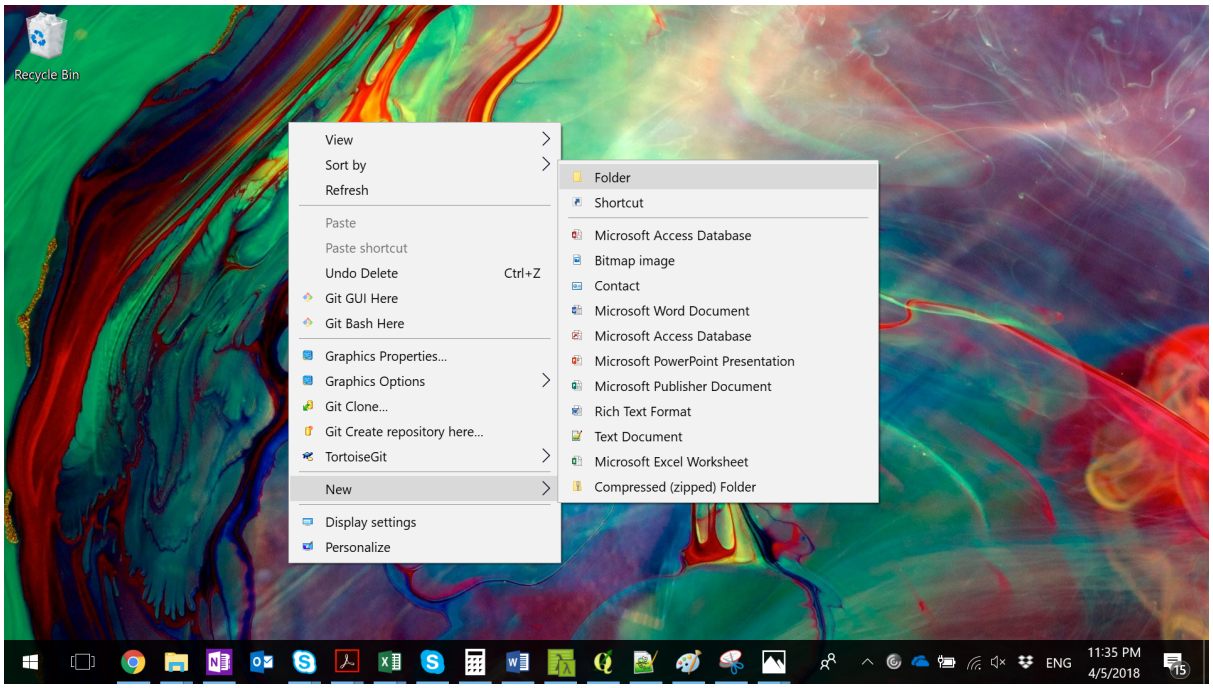
Task status & download

- Objective: Learn how to check the status of submitted tasks, download them and compute pyramids for faster visualization of results in QGIS.
- Estimated time of completion: 20 minutes
- Internet access: Required

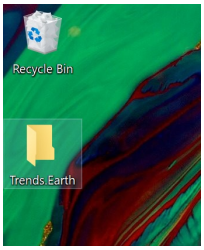
Note: Download this page as a PDF for offline use

The results of Trends.Earth analysis are rasters in TIF format for indicators and XLSX spreadsheets for the tabular outputs. You will need to define in each case where files will be stored in your computer. We recommend you create a folder where to store the results for easy posterior access. The Desktop is a location usually selected because it is easy to find.

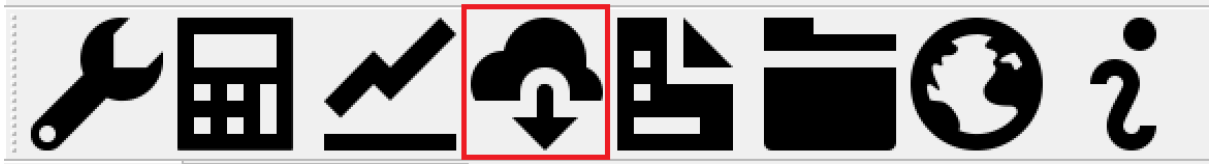
1. To create a folder in your computer's desktop, navigate there by minimizing all the windows and programs you have open (Note: not closing, simply removing them from the display).
2. Once in the Desktop, right click on an empty space and a menu will display.
3. Move your mouse cursor to the New option at the bottom of the menu, and another menu will show to the right.
4. Navigate with your mouse cursor to Folder and right-click.



5. A new folder named New Folder will appear on your desktop with the name highlighted in blue. Type the name you want to assign it. In this example, we named it Trends.Earth. Then press the Enter key on your keyboard to save the name.

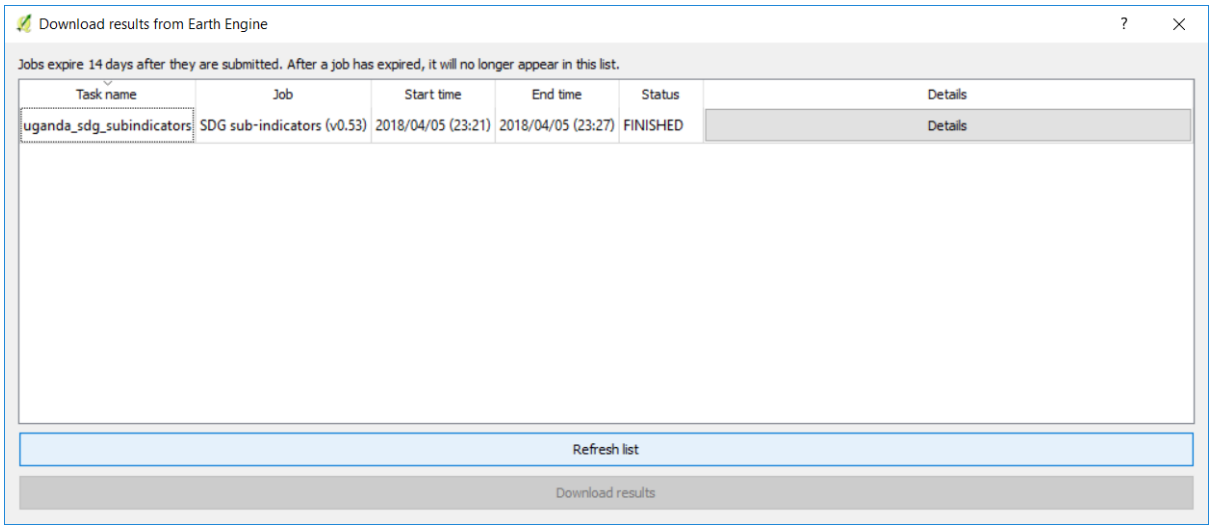


6. Navigate again to QGIS, and click on the cloud with the arrow facing down icon ( ) from the Trends.Earth toolbar.

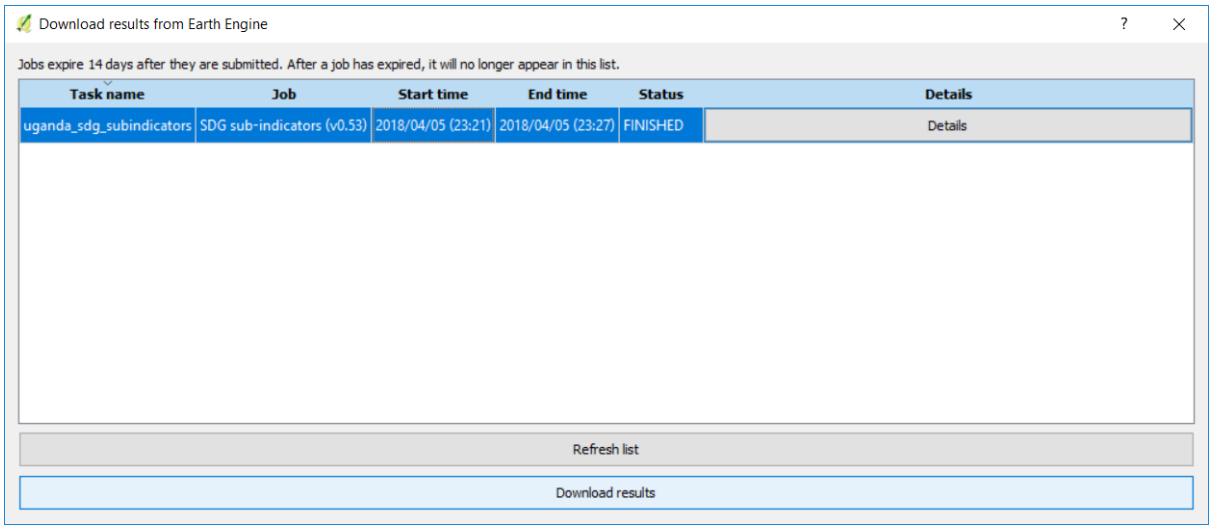


7. The Download results from Earth Engine will open. Click Refresh List to check the updated status of the tasks submitted in the previous section of the tutorial (Run 1-step subindicators). One of three messages will show there:

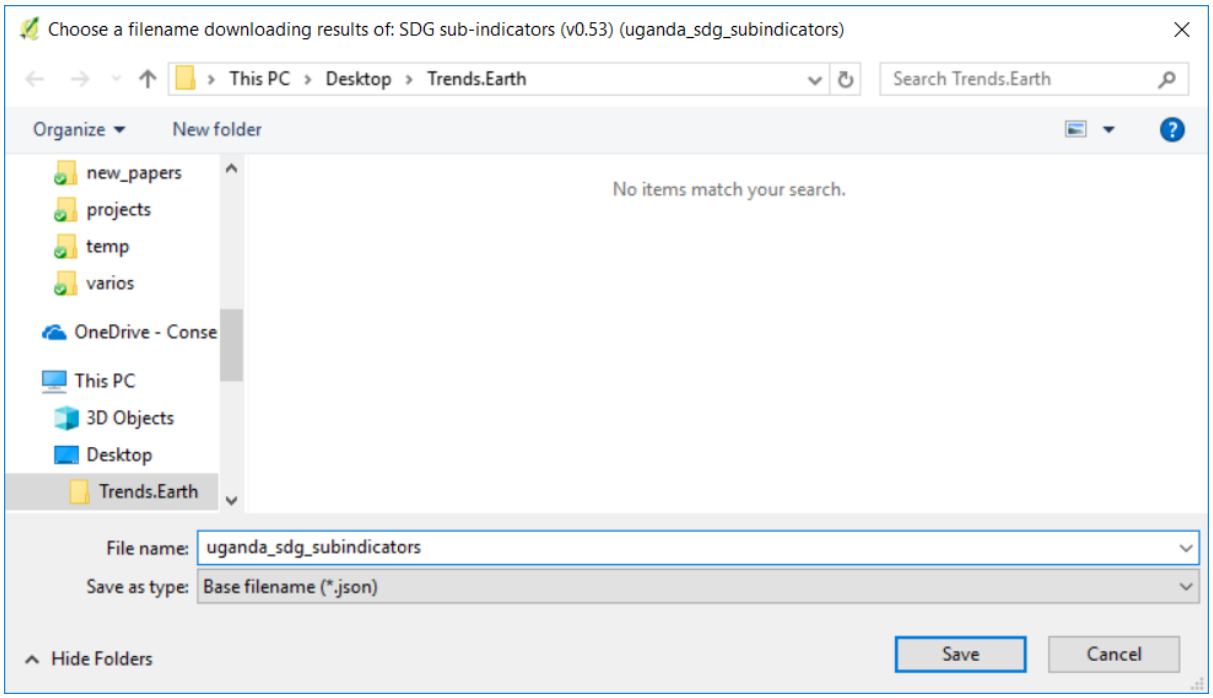
- RUNNING: The task has been successfully submitted to Earth Engine and it is being processed. Wait a few minutes and click Refresh list again.
- FINISHED: The task has been completed and it is ready to be downloaded.
- FAILED: There has been some error in the parameters selected and the task could not be completed. Please run the tool again to make sure all parameters are correct.



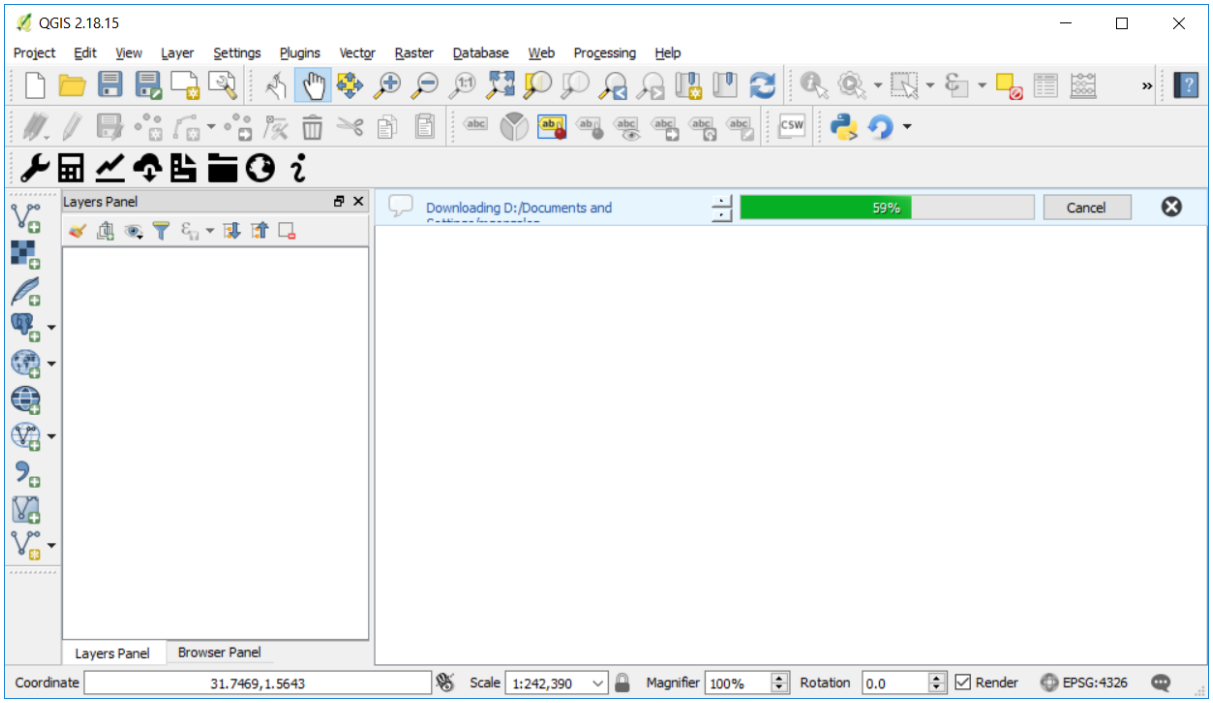
8. When the task shows status FINISHED you can select it by clicking on it (it will be highlighted in blue), and them click on the Download results button.



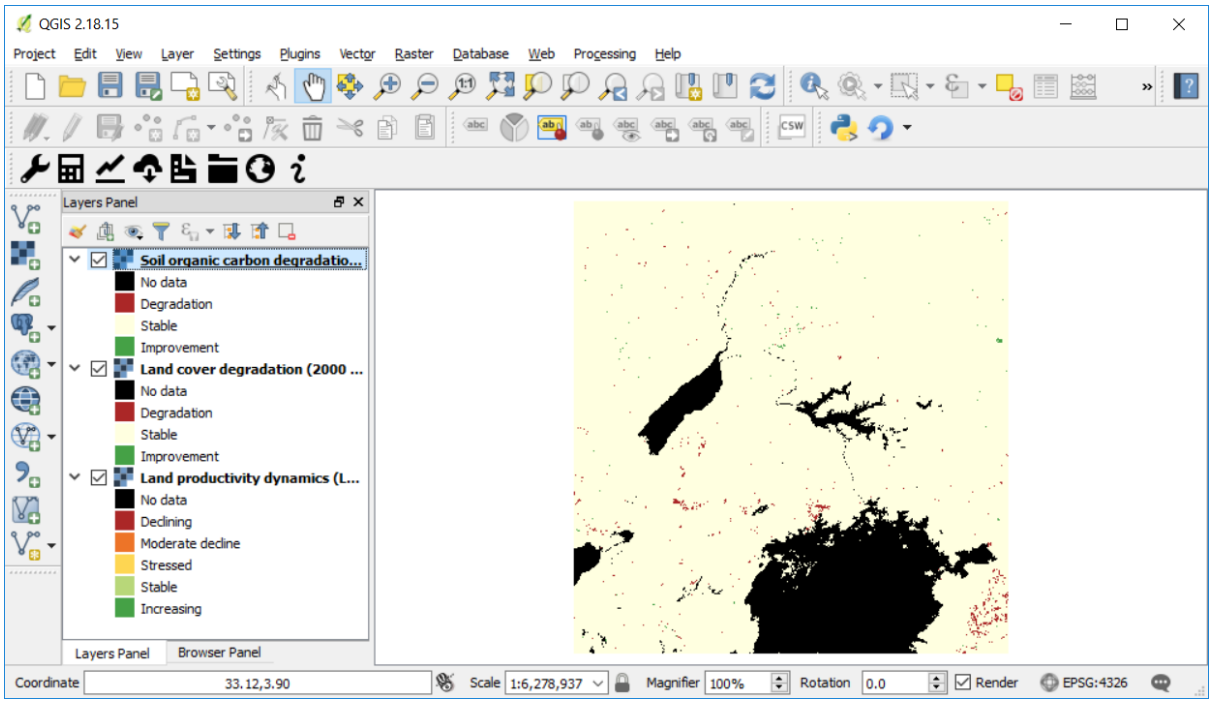
10. A window will open for you to define the location (the folder you just created on the Desktop) and the name of the output file. Make the name as informative as possible so you can tell what information it contains the next time you want to use those results.



11. The Download window will disappear and you will be brought back to the QGIS interface. You will see light blue progress bar indicating which percentage of the file has been downloaded. This could take from a few seconds to several minutes depending on the size of the area selected and the speed of the Internet connection available.



12. Once the download is completed, the results will be loaded in QGIS. In this example you'll see a layer for each of the SDG 15.3.1 computed: land productivity, land cover, and soil organic carbon.

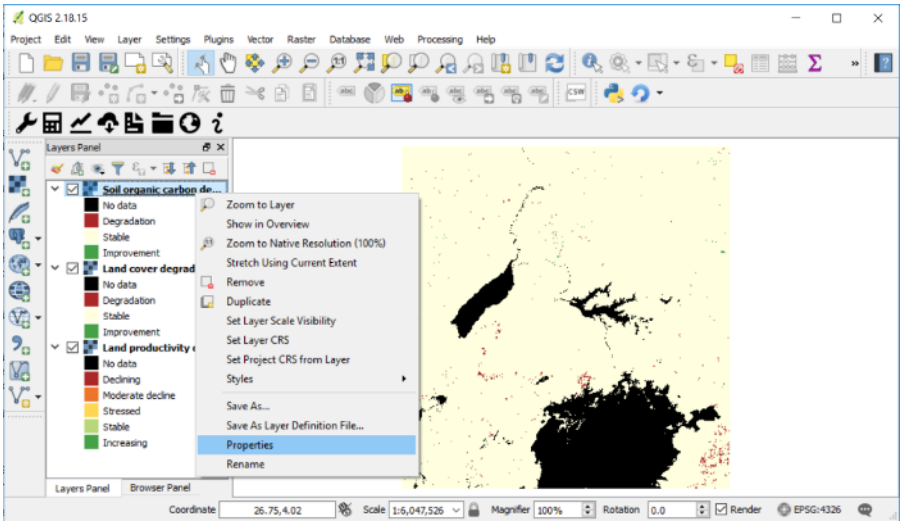


18.1 OPTIONAL: Computing Pyramids

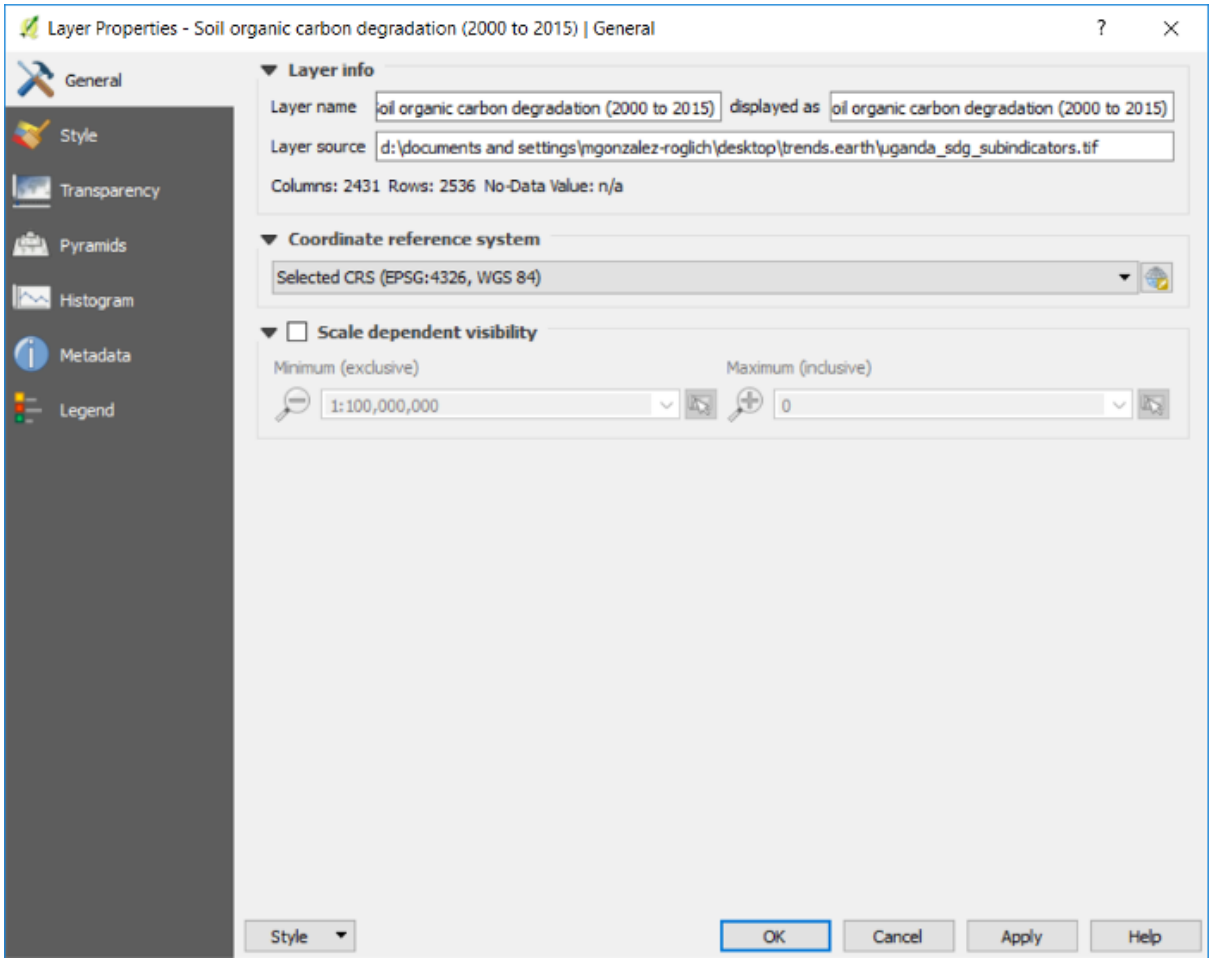
When the raster file is too big, due to a large study area, high spatial resolution, or a large number of bands in the file, the data could take several seconds to display. If you change the zoom or turn layers on an off frequently, this could make the work a bit frustrating. An option to overcome this is to compute Pyramids to the file. This process will take from minutes to hours to run depending on the size of the area, so make sure to have enough time for it to process. To compute pyramids you have to:

13. Navigate with your cursor to the layer you want to compute pyramids for and right click over it. A menu will open. Navigate to Properties and click on it.

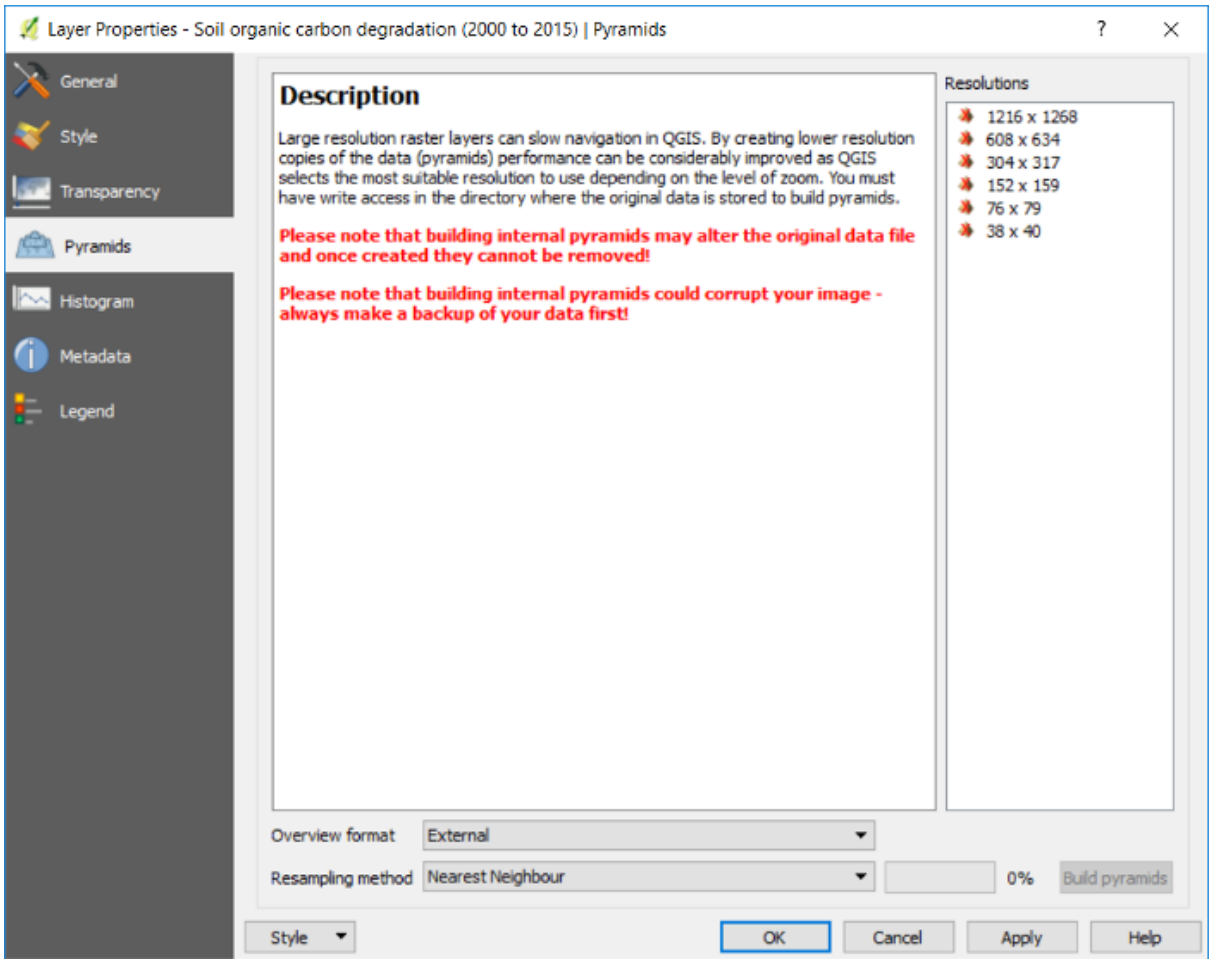
Note: When using the Calculate all three sub-indicators in one step option (described in the previous tutorial Run 1-step subindicators), all the bands are stored in a single TIF file, so even though you see three layers loaded in the QGIS window, they all refer to the same file. This means that the pyramids need to be computed only once for the three sub-indicators.



14. The Layer Properties menu will open. From the options on the left, navigate to Pyramids and click on it.



15. Once on the Pyramids tab you will see a description about they are.

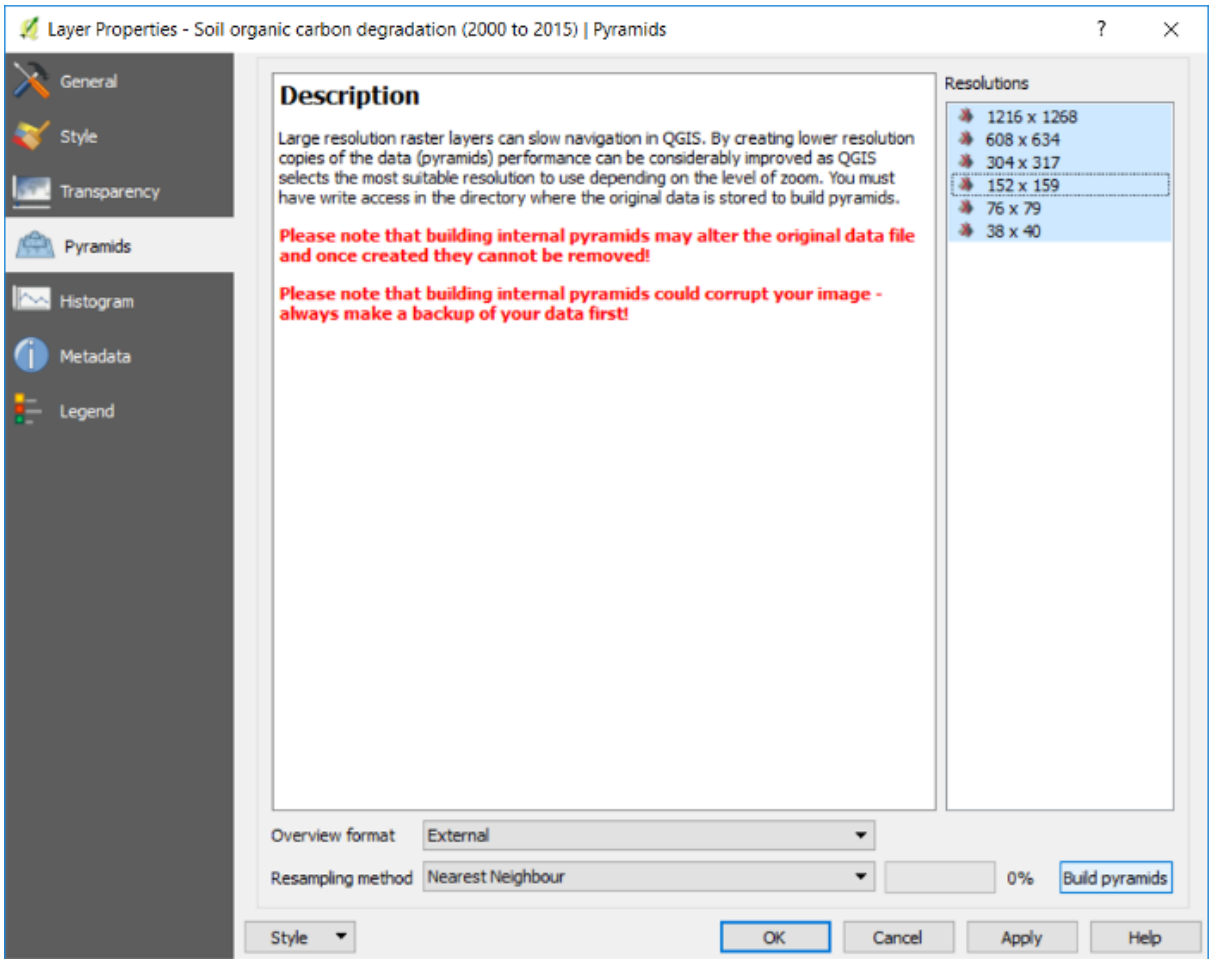


16. To the right of the window you will see the Resolutions options. Selecting all of them will make displaying in QGIS the fastest, but this could take hours to compute depending on the file size and processing capabilities of the computer you are using. For the Uganda example, we can select them all, but if using a larger area or higher spatial resolution than the default 250m, we recommend you select alternating resolutions options (i.e. one resolution selected and one not selected, and so on). Resolutions are selected by clicking on them. When selected, they will turn blue.

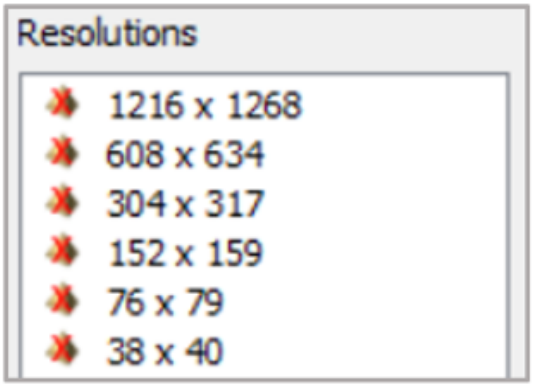
    Make sure that the settings at the bottom are set to:

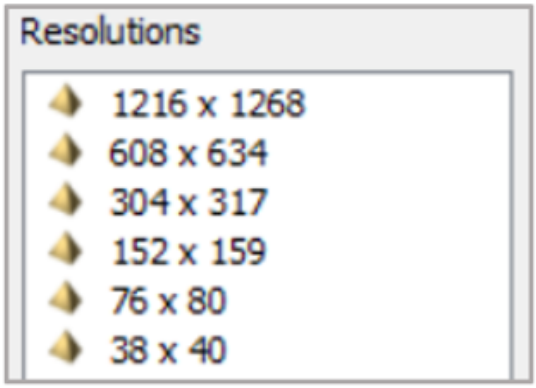
    - Overview format: External
    - Resampling method: Nearest Neighbour

16. Then click on the Build pyramids button. The progress bar next to it will show which percentage of the task has been completed.



17. When pyramids have been built you will notice that the icons next to the resolutions will have changed from red crosses to yellow pyramids.





18. Click OK to go back to the QGIS main interface.

CHAPTER 19

Use custom productivity data

- Objective: Learn how to load custom land productivity data computed outside of Trends.Earth.
- Estimated time of completion: 20 minutes
- Internet access: Not required

Note: Download this page as a PDF for offline use

Land productivity data should be formatted following UNCCD guidelines for reporting indicating areas of declining, early signs of decline, stable but stressed, stable, or increasing primary productivity.

For the productivity data to be used in Trends.Earth the file need to be coded in the following way:

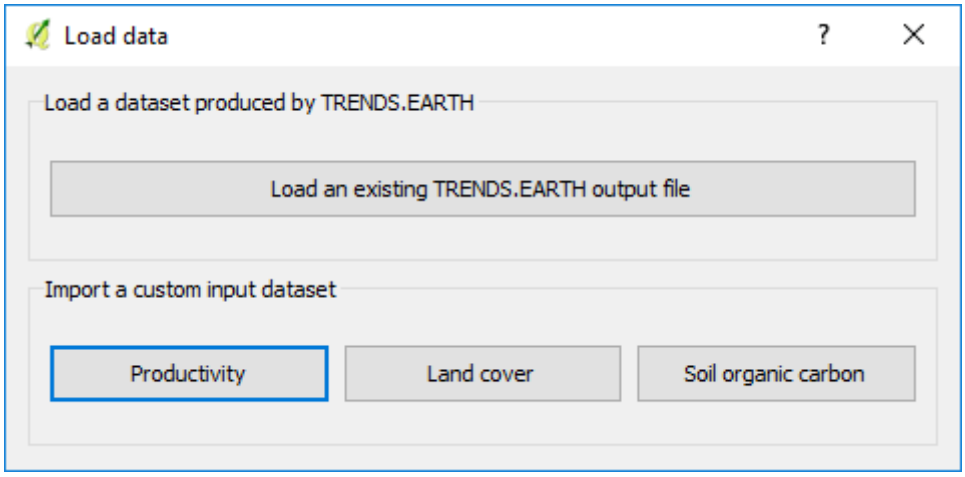
- Declining = 1
- Early signs of decline = 2
- Stable but stressed = 3
- Stable = 4
- Increasing = 5
- No data = 0 or -32768

If your layer is not coded in such a way, please do the necessary adjustments prior to using Trends.Earth.

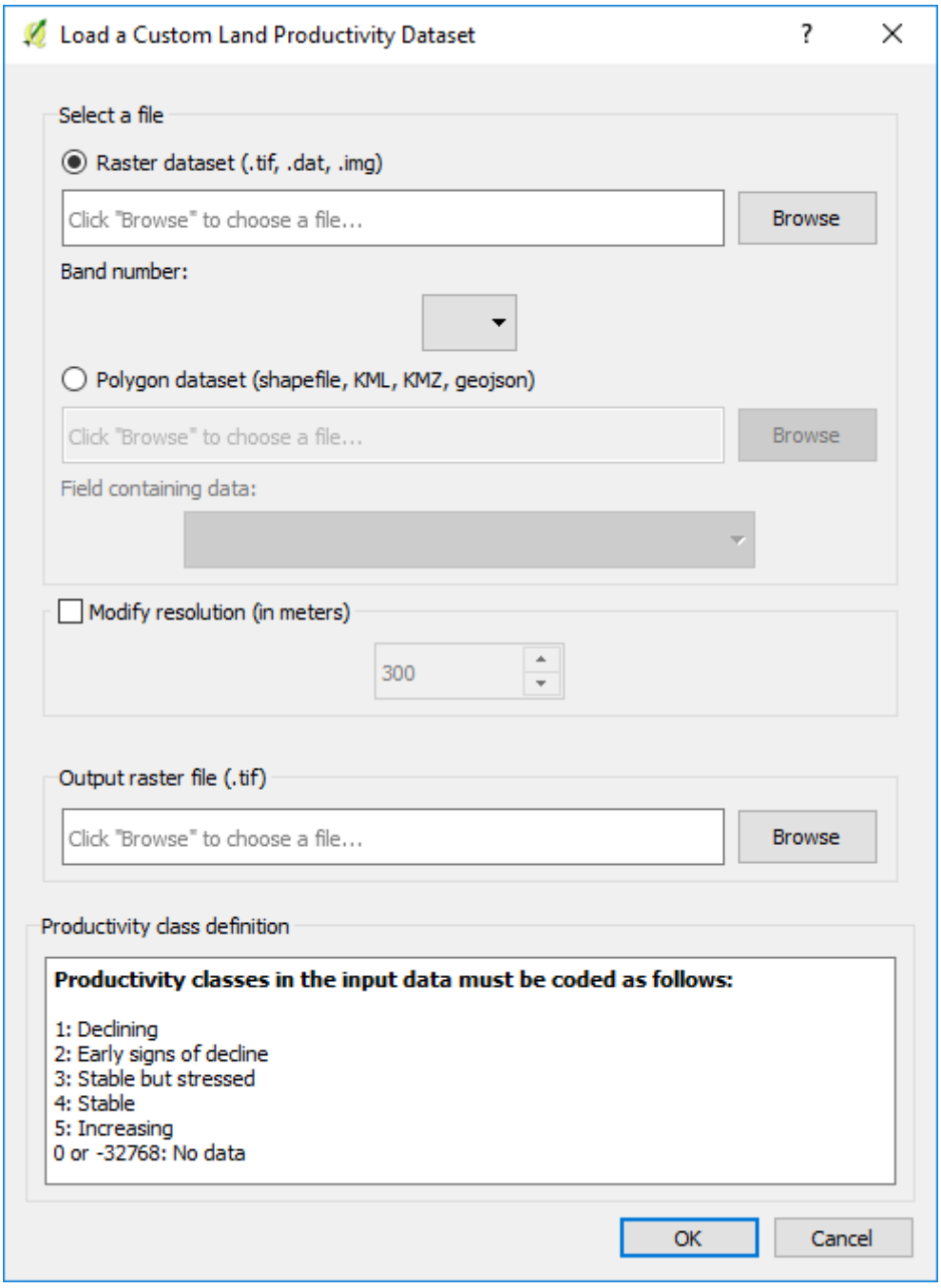
1. To load productivity data click on the ( ) icon in the Trends.Earth toolbar.



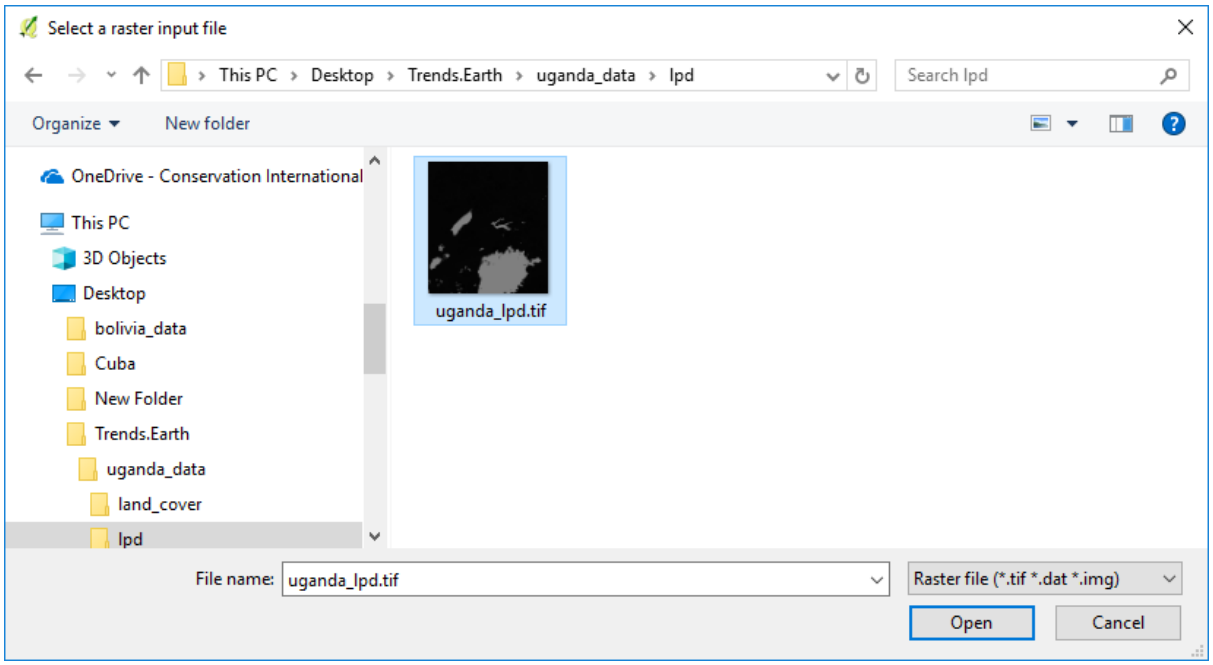
2. The Load data menu will open. Select Productivity from the Import a custom input dataset section.



3. In the Load a Custom Land Productivity Dataset use the radio button to select the format of the input file (raster or vector). For this tutorial select raster, since the data distributed by the UNCCD is in raster format. Click on Browse to navigate to the productivity file you wish to import.

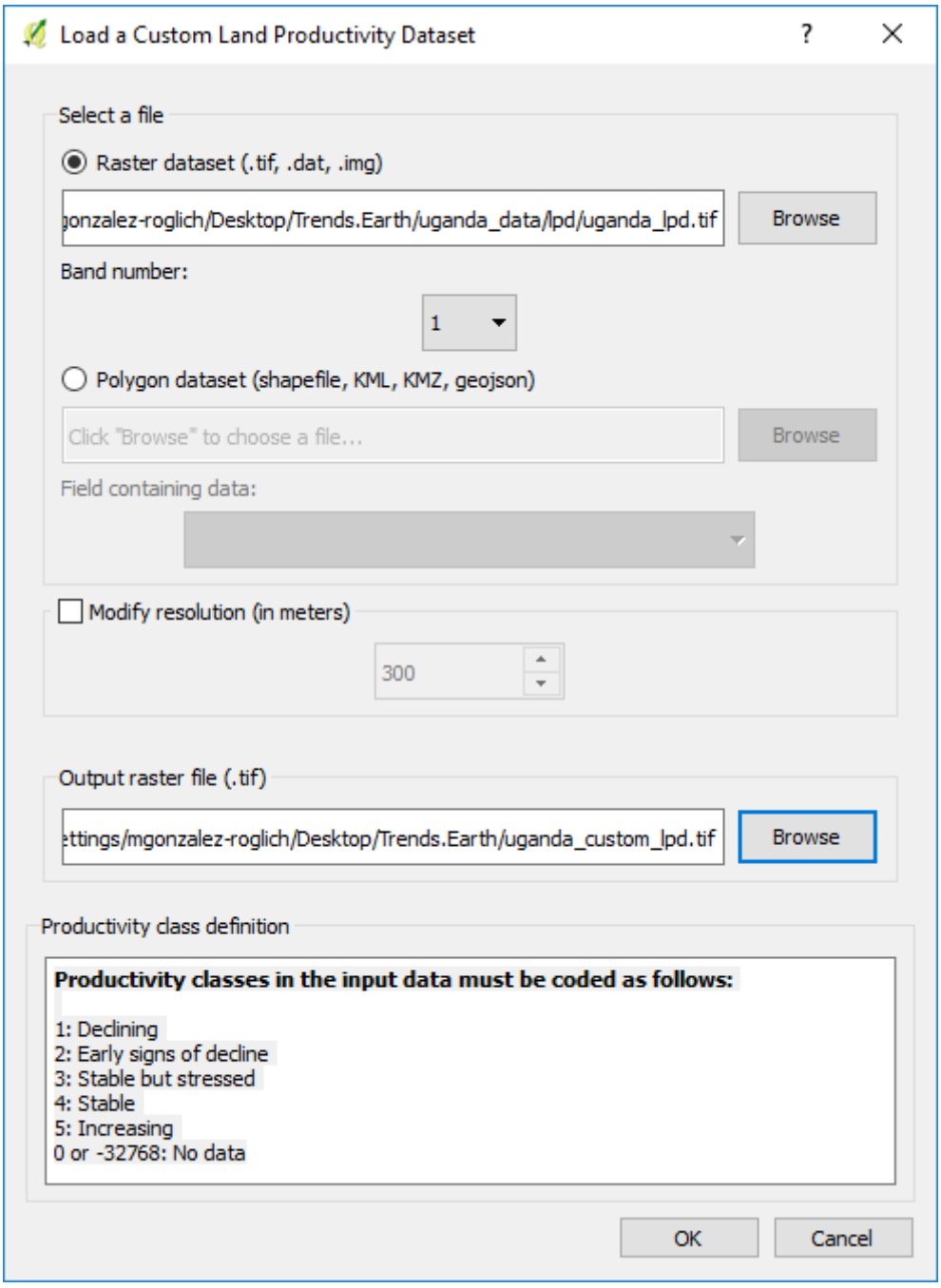


4. Use the Select input file window to navigate to the file to be imported, select it, and click Open.



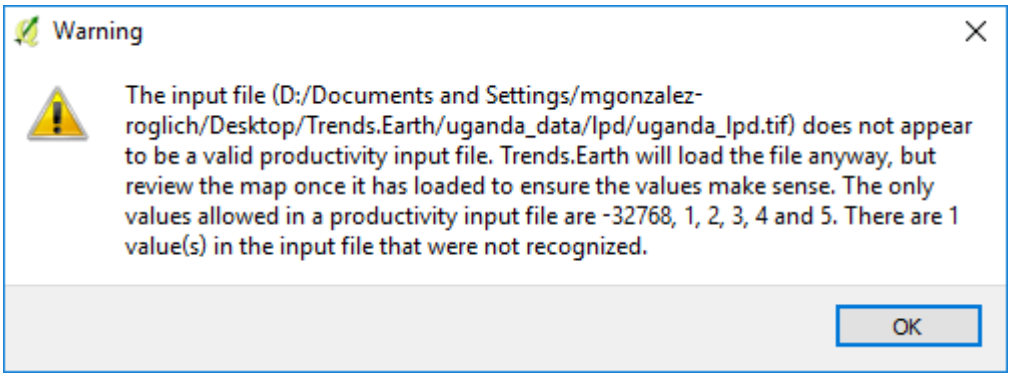
5. Back at the Load a Custom Land Productivity Dataset window you have options for selecting the band number in which the productivity data is stored, in case your input file is a multi band raster. You also have the option of modifying the resolution of the file. We recommend leaving those as defaults unless you have valid reasons for changing them.

6. Click Browse at the bottom of the window to select the Output raster file and navigate to the folder where you want to save the file. Assign it a name and click OK.

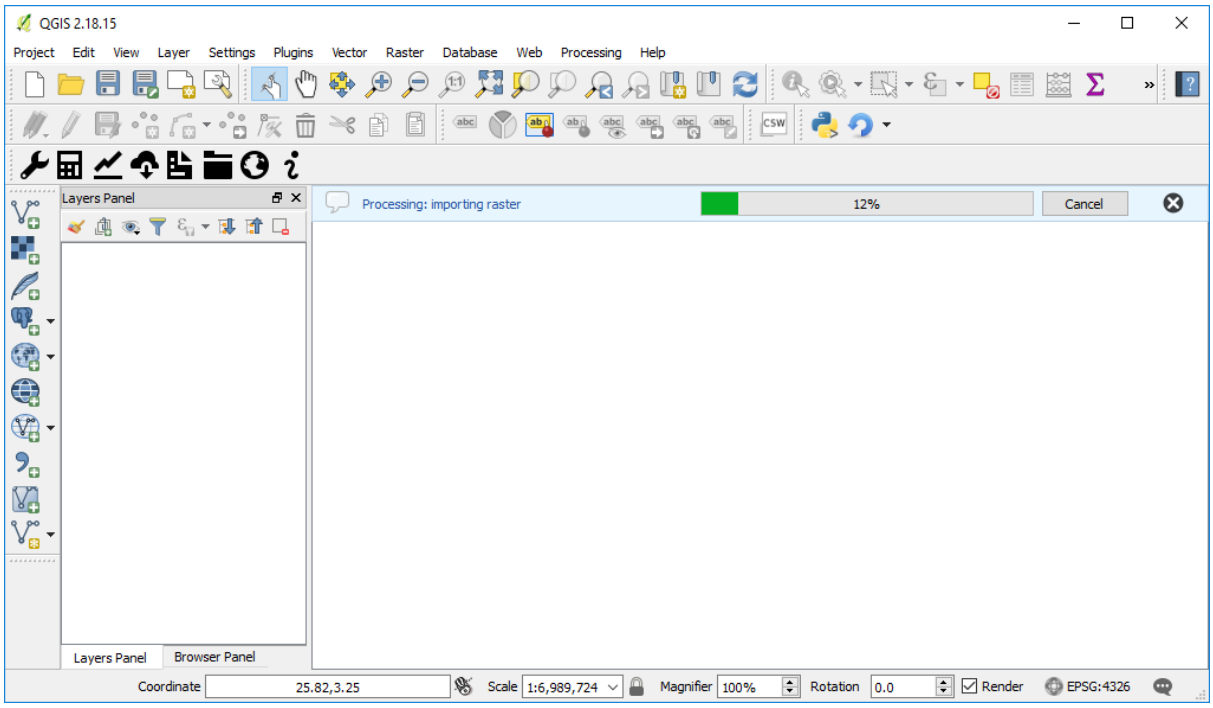


5. Back at the Load a Custom Land Productivity Dataset window click OK on the lower right corner to process the data.

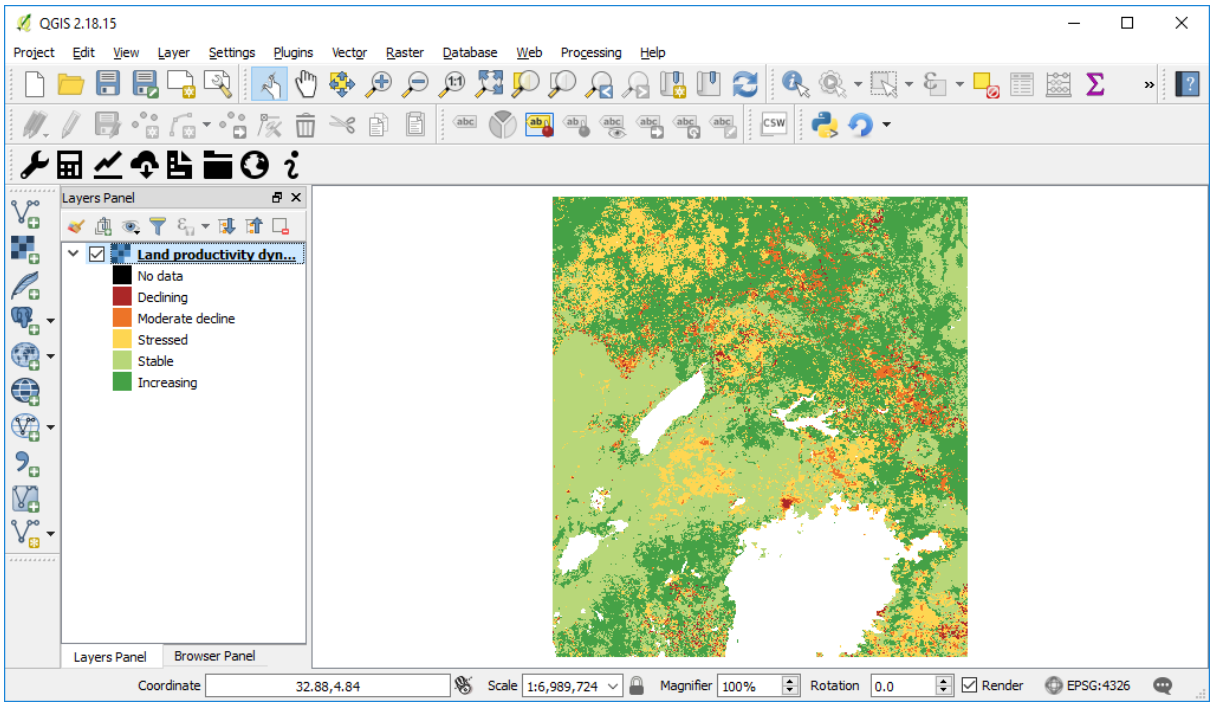
6. If the values of the input file do not exactly match the requirements describe above, you will see a warning message. In many cases the warning is triggered by the definition of NoData, but the tool will still try to import it. For that reason, it is extremely important for you to explore the output layer to make sure the results are mapped as expected.



7. Once you click OK in the warning window, a progress bar will appear showing the percentage of the task completed.



8. When the processing is completed, the imported land productivity dataset will be loaded to QGIS.



Note: Refer to the Compute SDG indicator tutorial for instructions on how to use the imported LPD to compute the final SDG 15.3.1 after integration with land cover and soil organic carbon.

CHAPTER 20

Use custom land cover data

- Objective: Learn how to load custom land cover data and to compute the land cover change sub-indicator using Trends.Earth.
- Estimated time of completion: 40 minutes
- Internet access: Not required

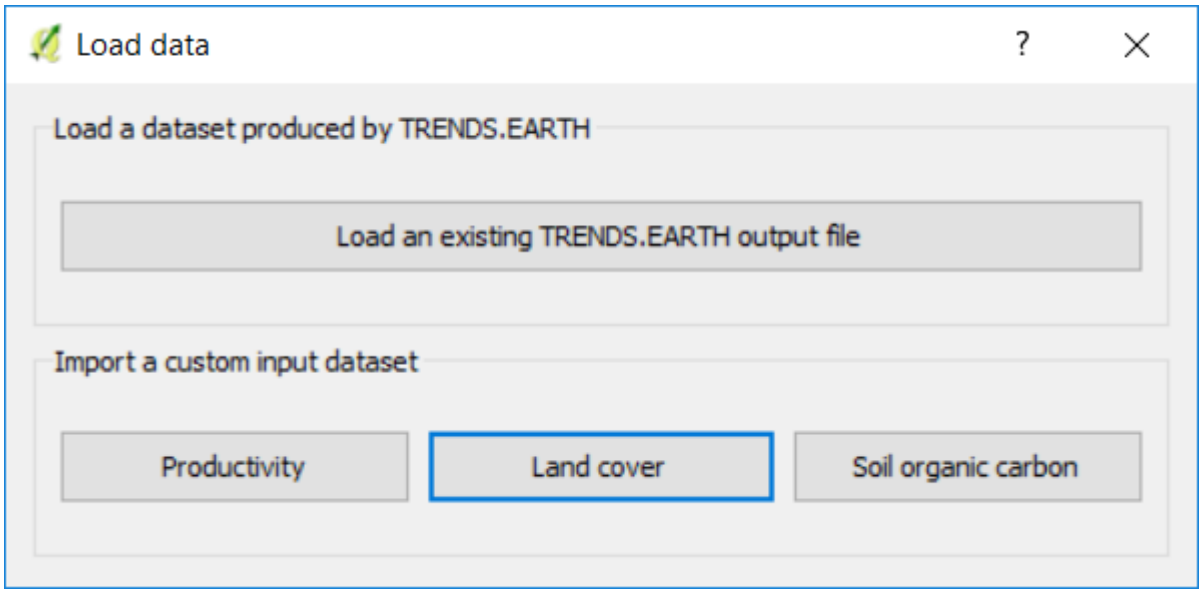
Note: Download this page as a PDF for offline use

Note: The land cover dataset for this tutorial were provided by the Regional Centre For Mapping Resource For Development and can be downloaded from this link.

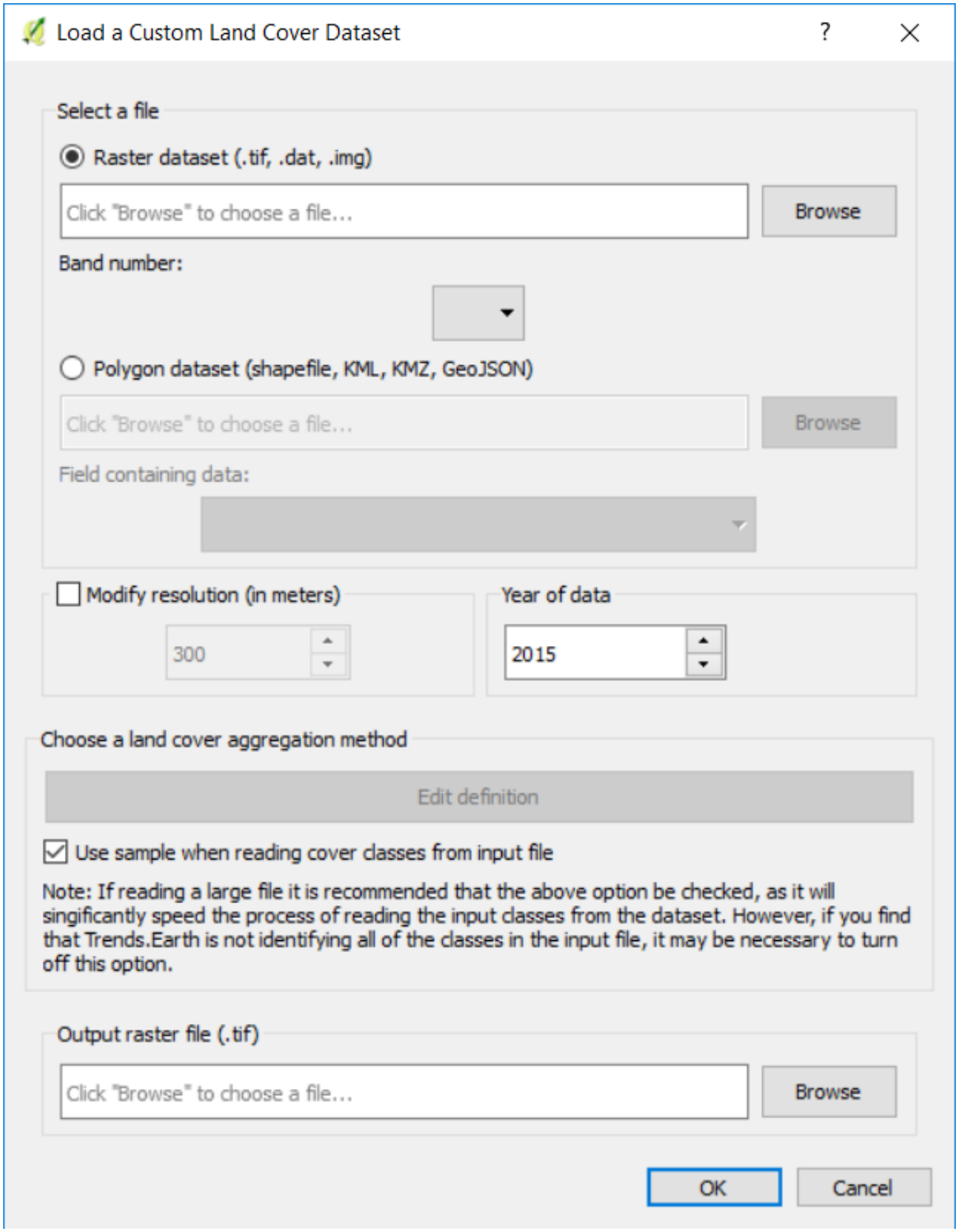
1. To load custom land cover data click on the ( ) icon in the Trends.Earth toolbar.



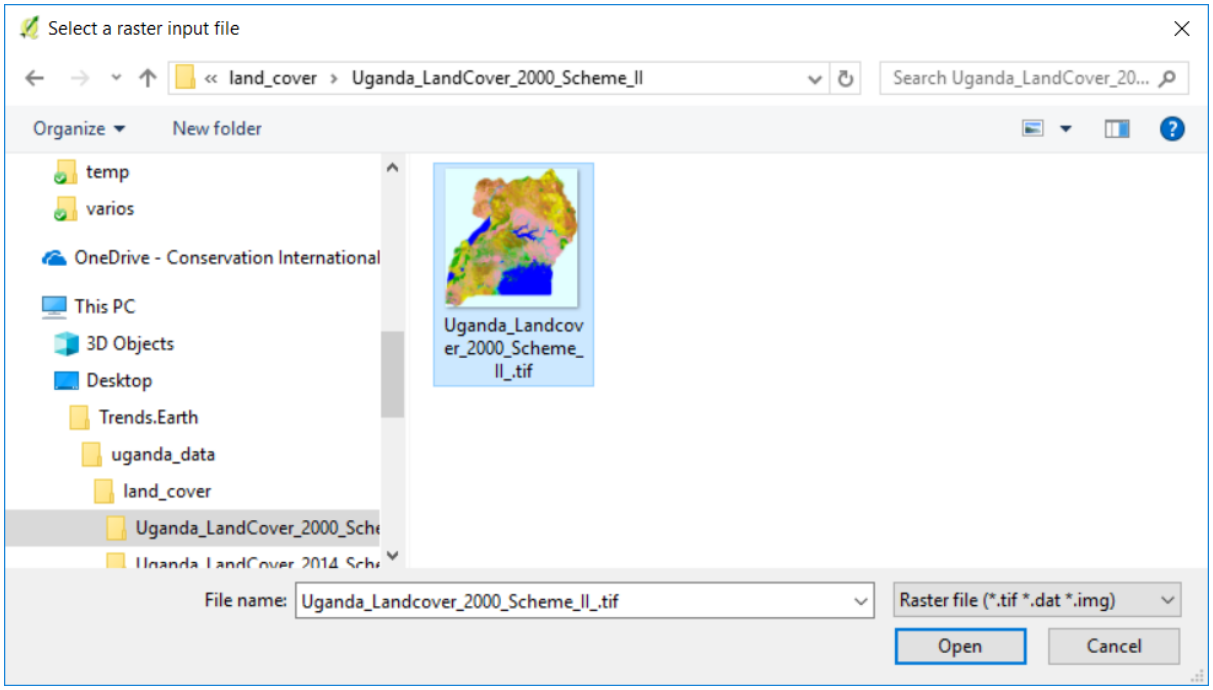
2. The Load data menu will open. Select Land cover from the Import a custom input dataset section.



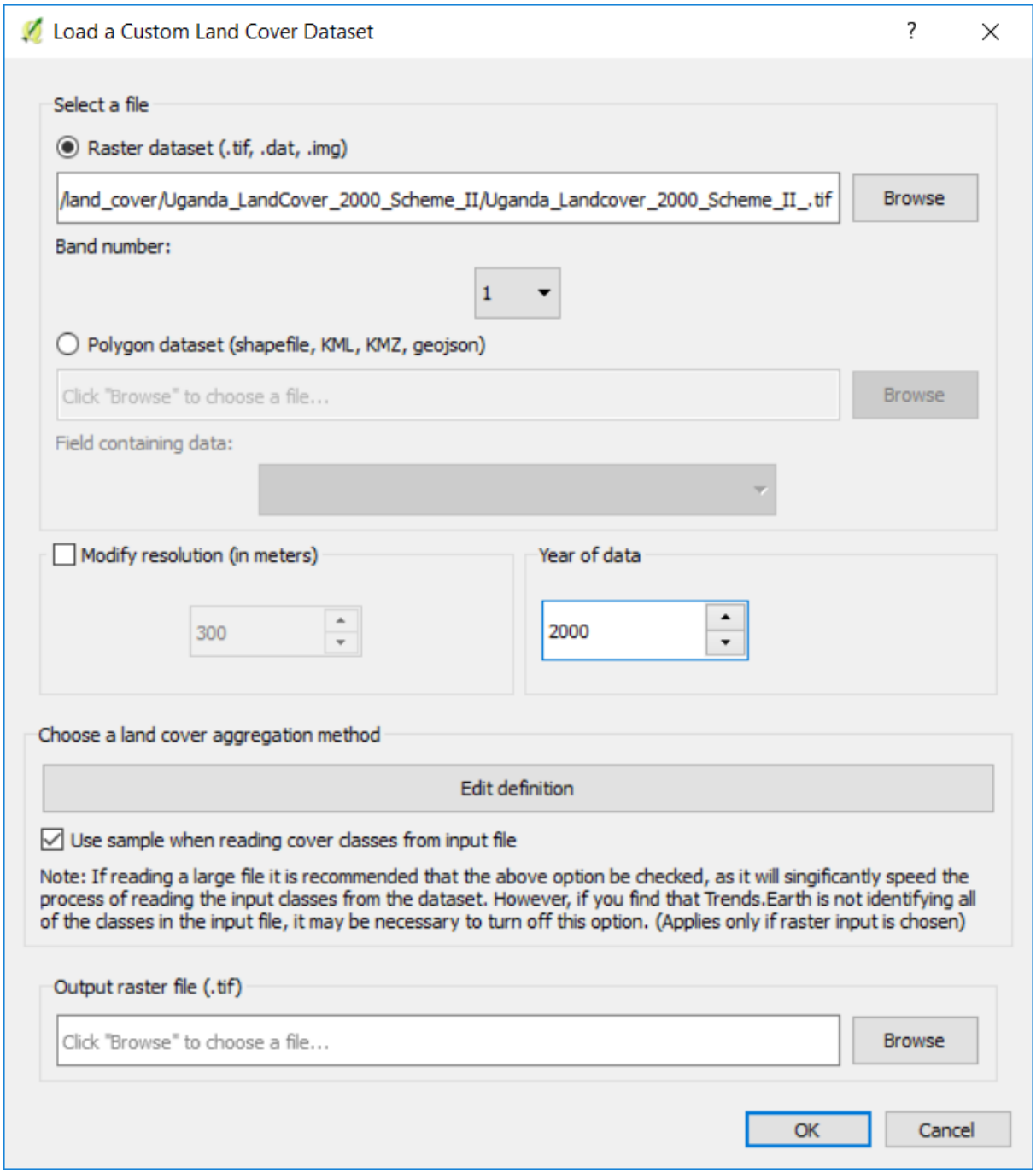
3. In the Load a Custom Land Cover dataset use the radio button to select the format of the input file (raster or vector). For this tutorial select raster, but you could run it with your land cover vector data if you prefer. Click on Browse to navigate to the land cover file you wish to import.



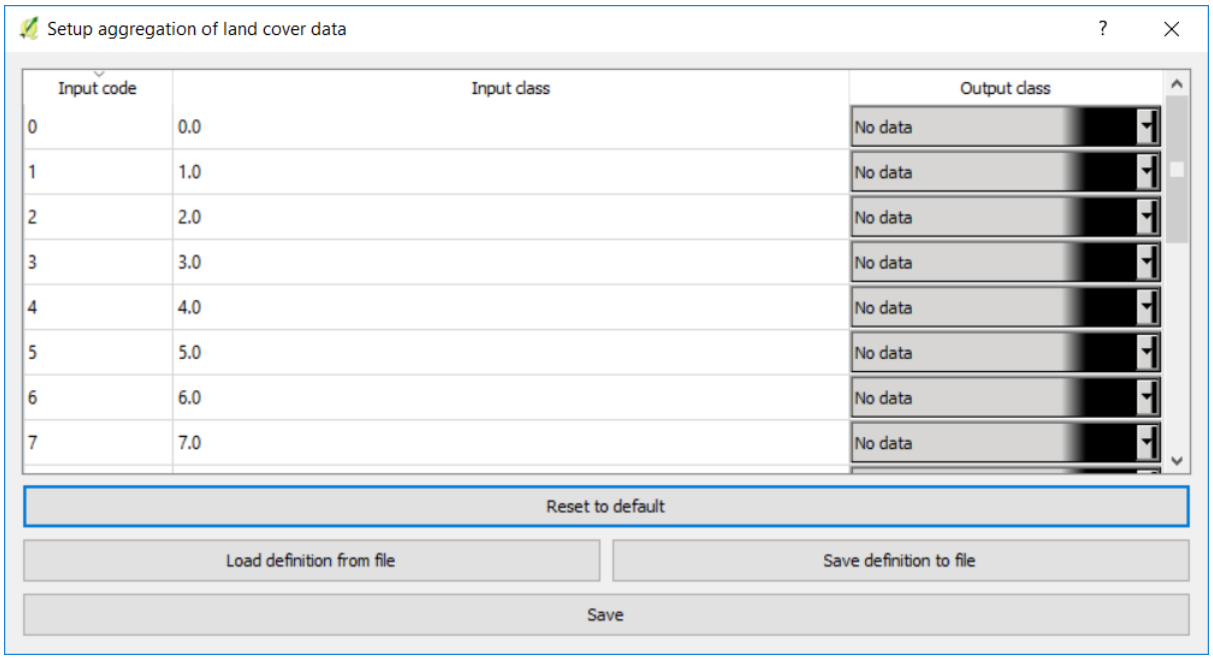
4. Use the Select input file window to navigate to the file to be imported, select it, and click Open.



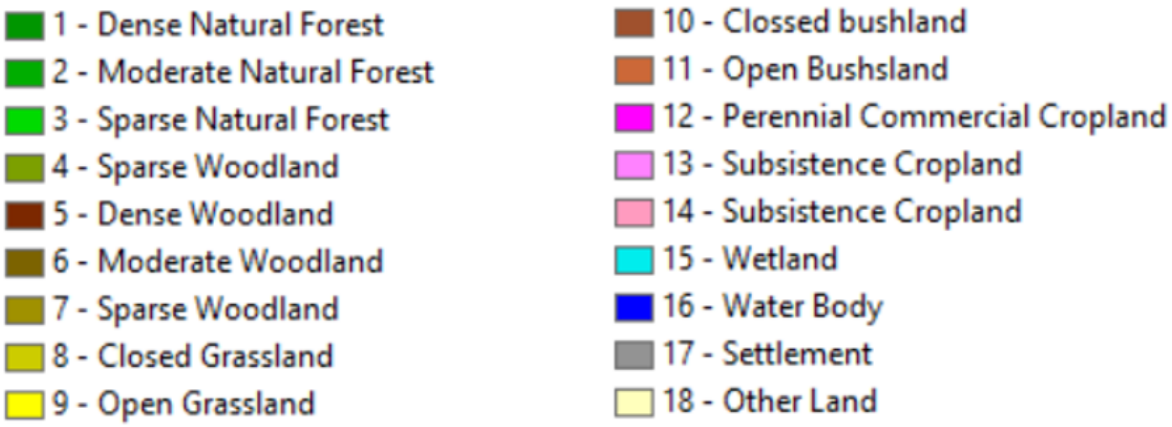
5. Back at the Load a Custom Land Cover dataset window you have options for selecting the band number in which the productivity data is stored, in case your input file is a multi band raster. You also have the option of modifying the resolution of the file. We recommend leaving those as defaults unless you have valid reasons for changing them.
6. Define the year of reference for the data. In this case, since the land cover dataset for Uganda was developed for the year 2000, define it as such. Make sure you are assigning the correct year.
7. Click Browse at the bottom of the window to select the Output raster file.



8. Click on the Edit definition button, this will open the Setup aggregation of land cover data menu. Here you need to assign each of the original input values of your dataset to one of the 7 UNCCD recommended land cover classes.



For this example, the Uganda dataset has 18 land cover classes:



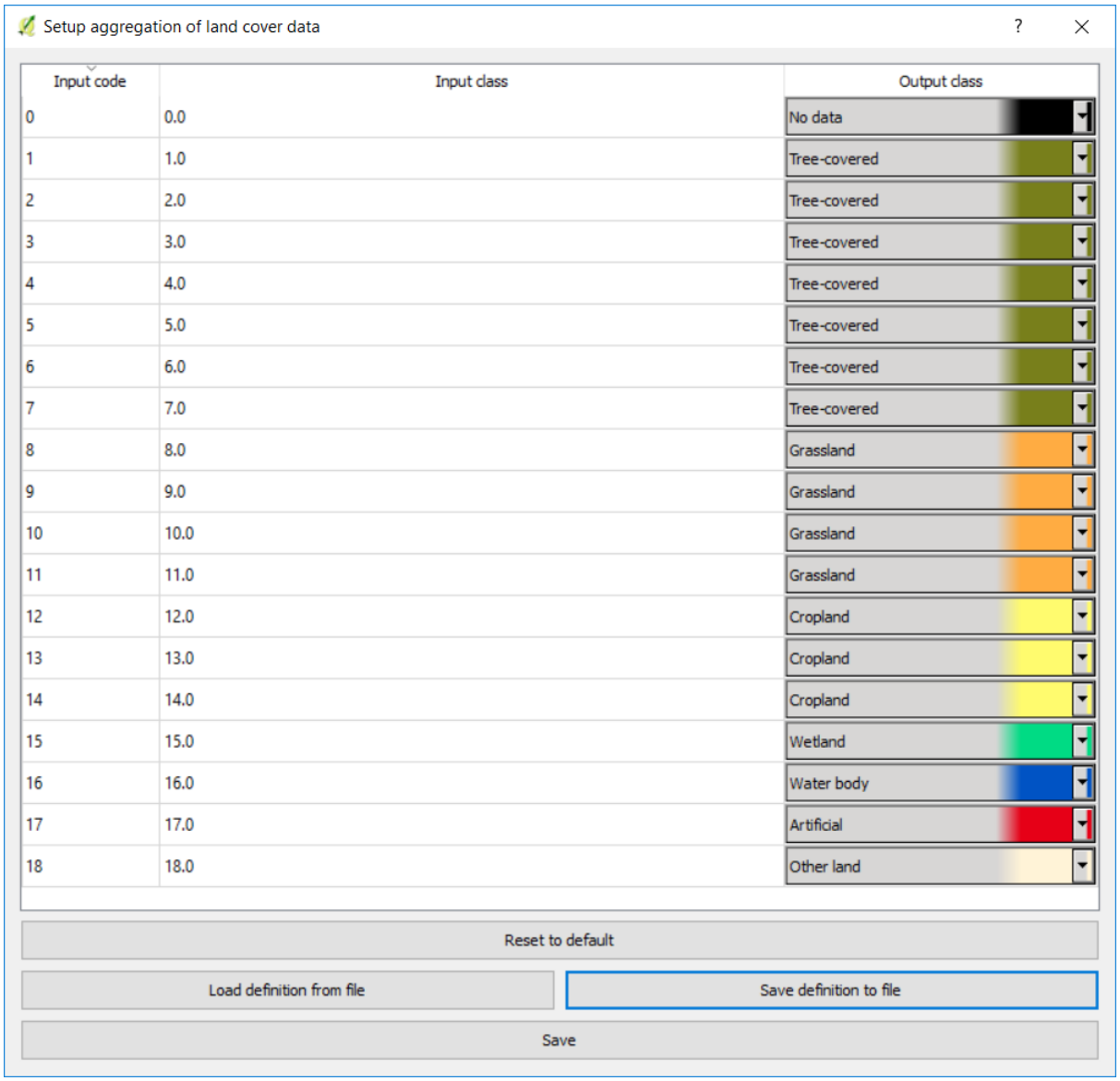
From the Metadata of the land cover dataset, we know that the best aggregation approach is the following:

- No data = 0
- Tree covered = 1 through 7
- Grassland = 8 through 11
- Cropland = 12 through 14
- Wetland = 15
- Water body = 16
- Artificial = 17
- Other land = 18

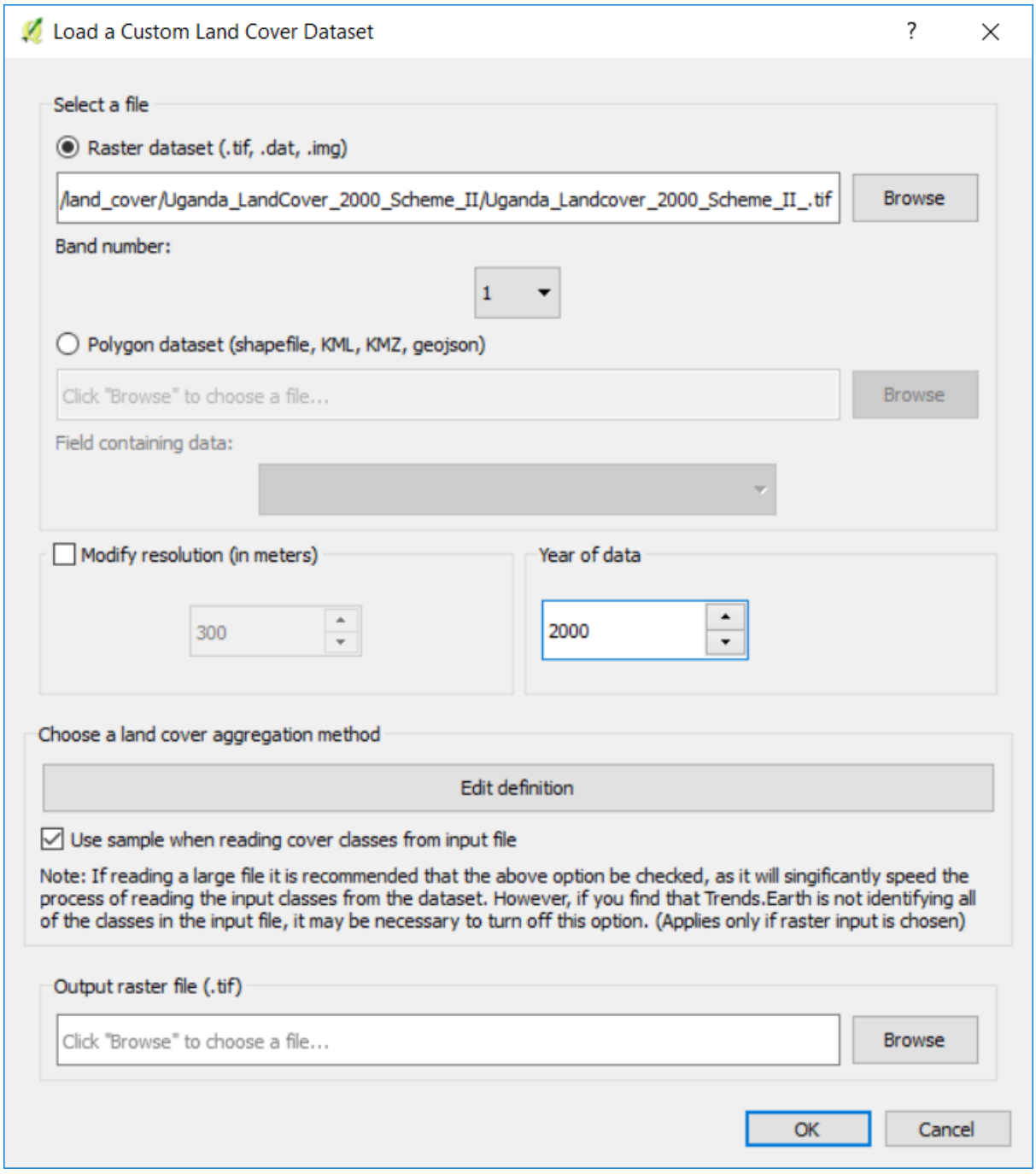
9. Use the Setup aggregation of land cover data menu to assign to each number in the Input class its corresponding Output class.

   When you are done editing, click Save definition file. This option will save you time next time you run the tool, by simply loading the definition file you previously saved.

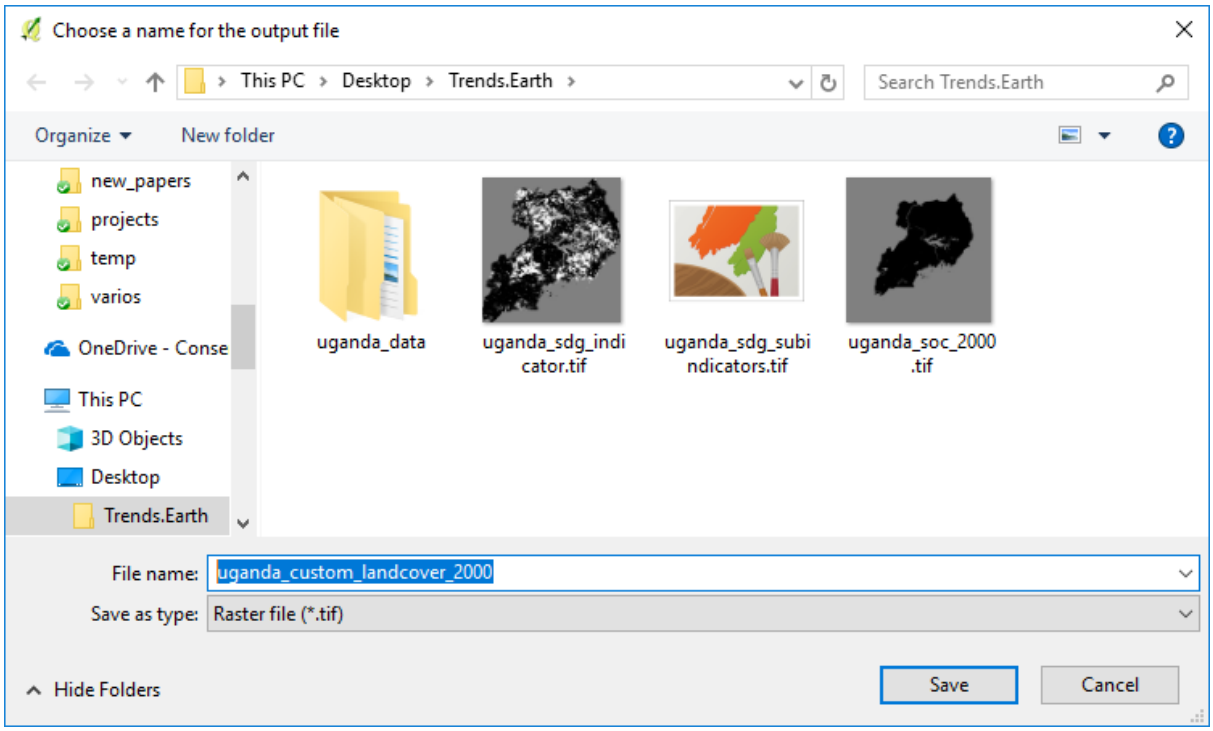
   Click Save to continue



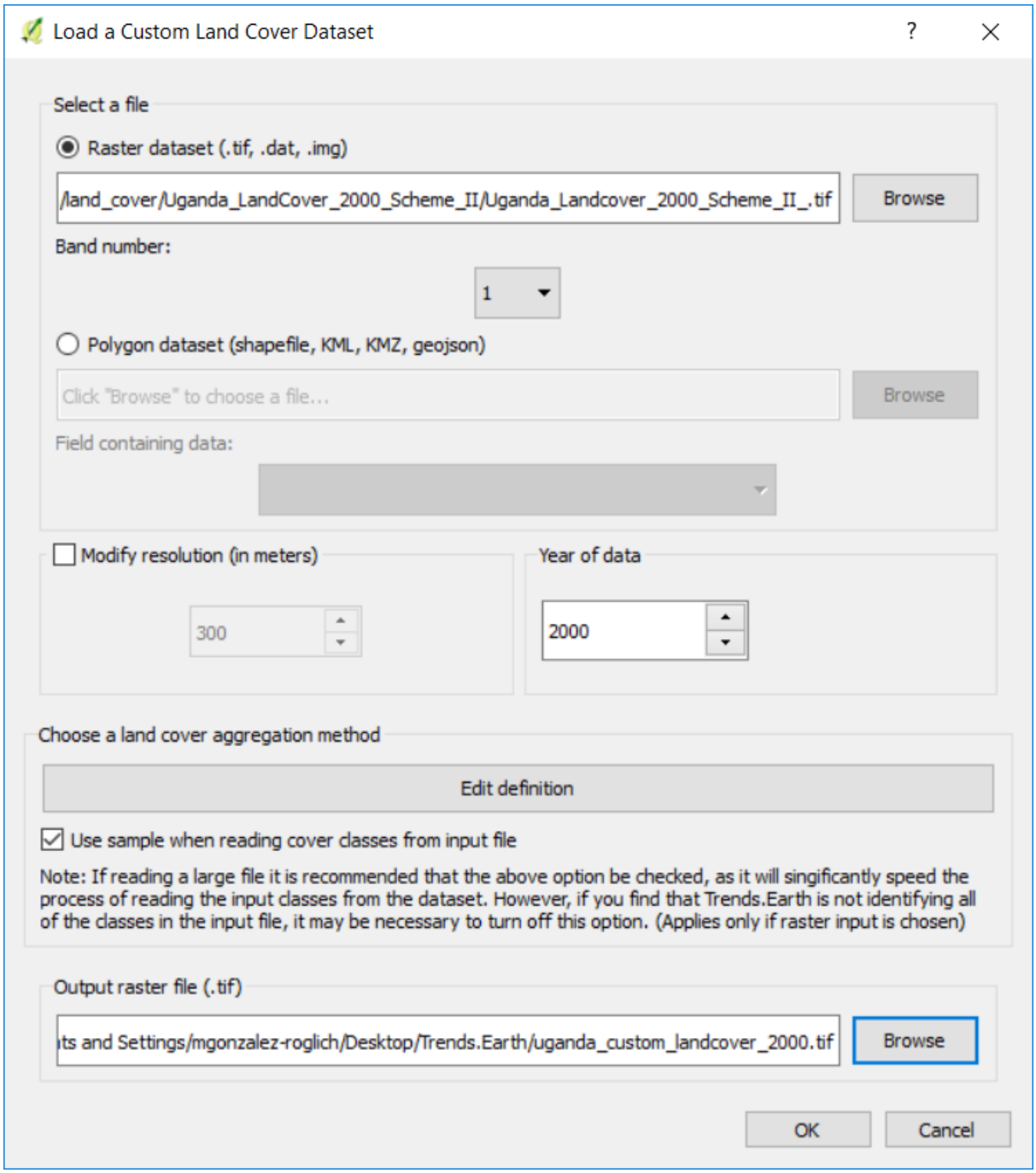
7. Back at the Load a Custom Land Cover dataset window, click Browse at the bottom of the window to select the Output raster file.



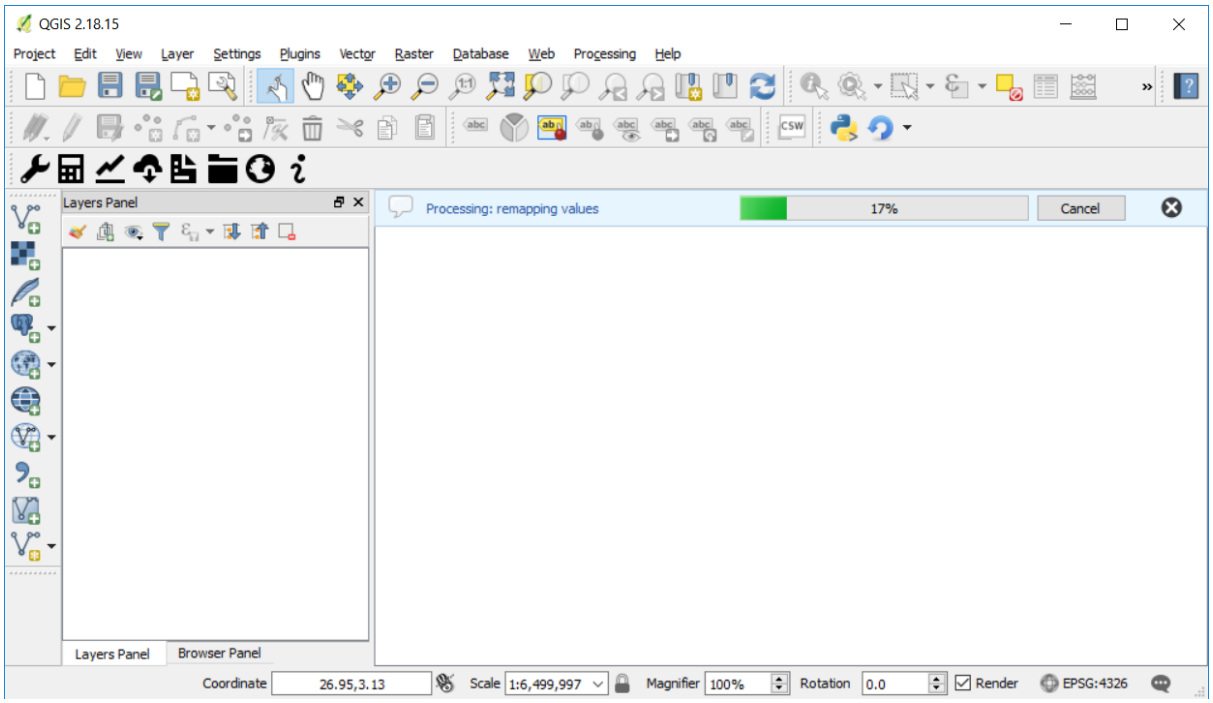
8. Navigate to the folder where you want to save the file. Assign it a name and click Save.



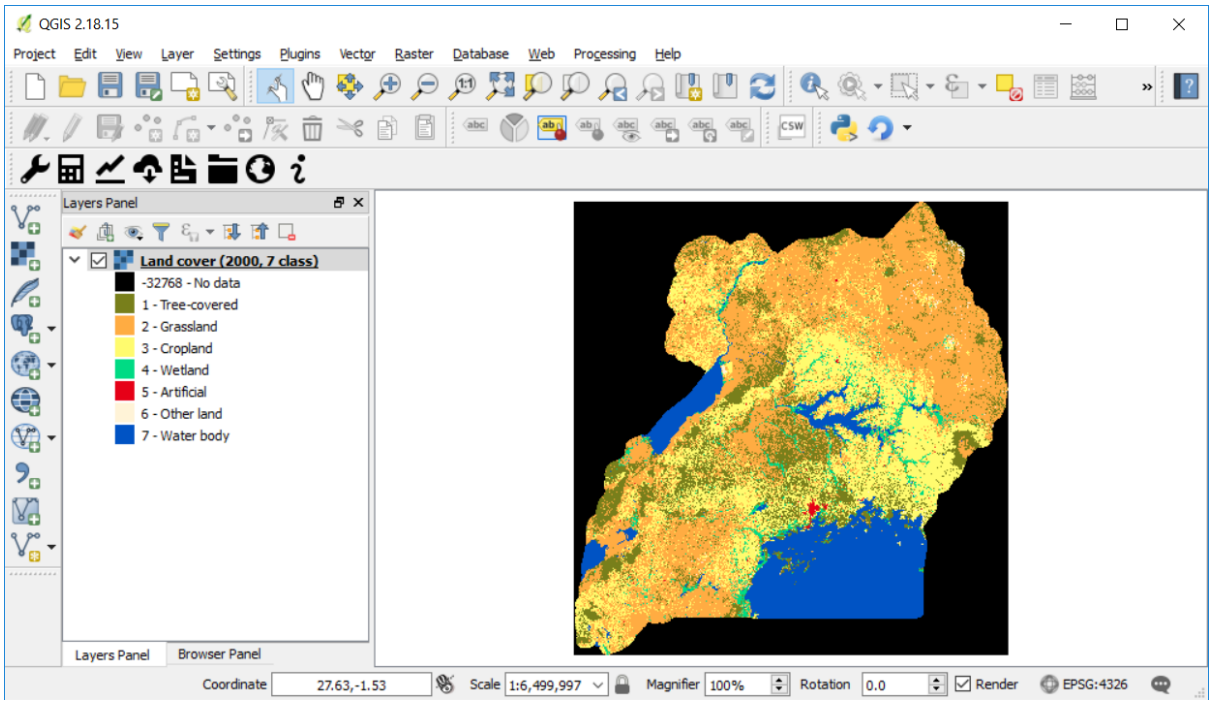
9. Back at the Load a Custom Land Cover dataset click OK for the tool to run.



10. A progress bar will appear showing the percentage of the task completed.

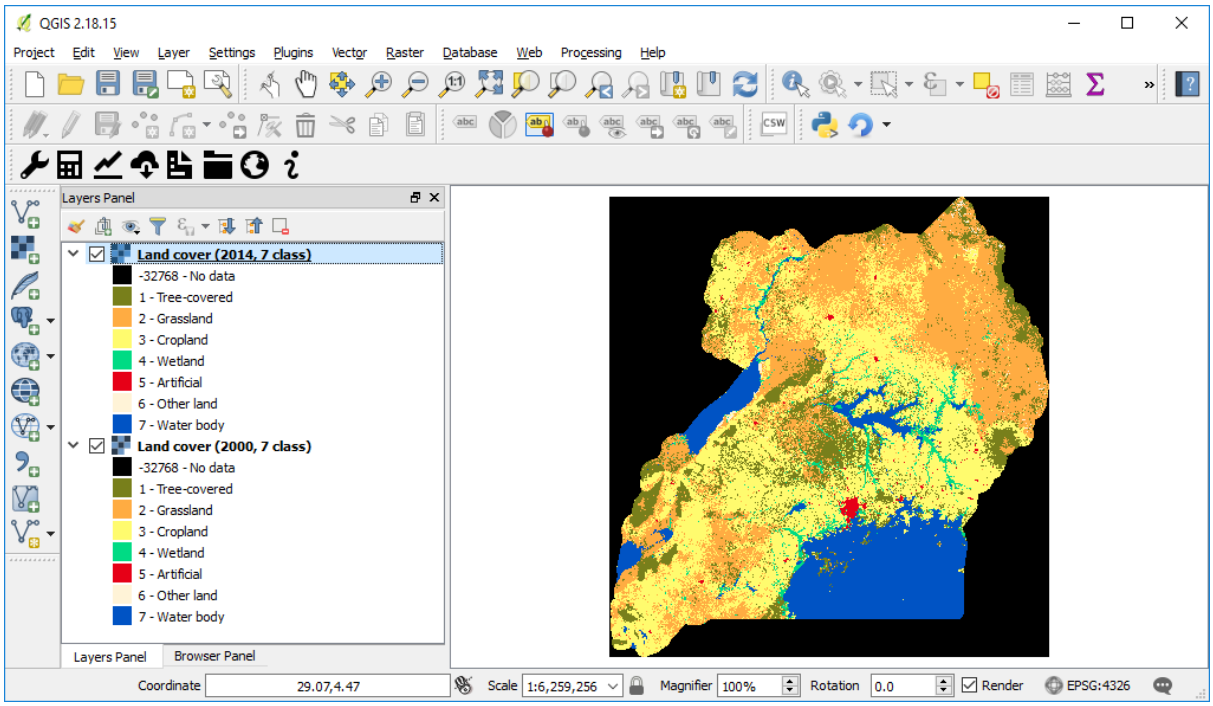


11. When the processing is completed, the imported land cover dataset will be loaded to QGIS.



Note: You have one imported custom land cover data for one year (2000), but two are needed to perform the land cover change analysis. Repeat now steps 1 through 11, but this time with the most recent land cover map. For this tutorial, we will use another land cover map from Uganda from the year 2015. Make sure to change the year date in the import menu.

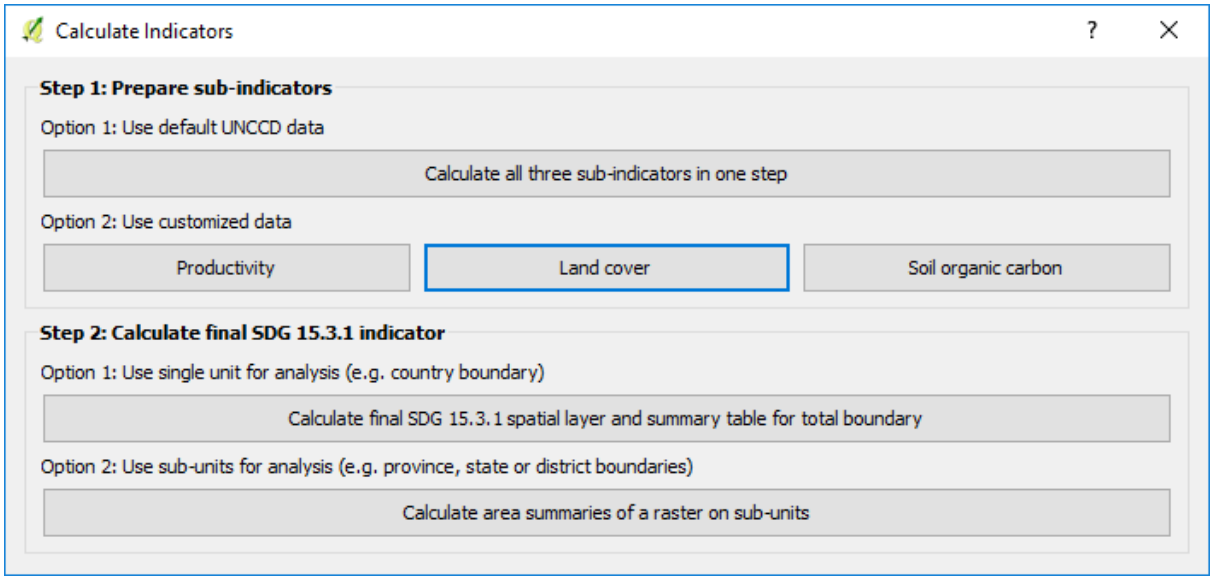
12. Once you have imported the land cover maps for years 2000 and 2015, you should have them both loaded to QGIS.



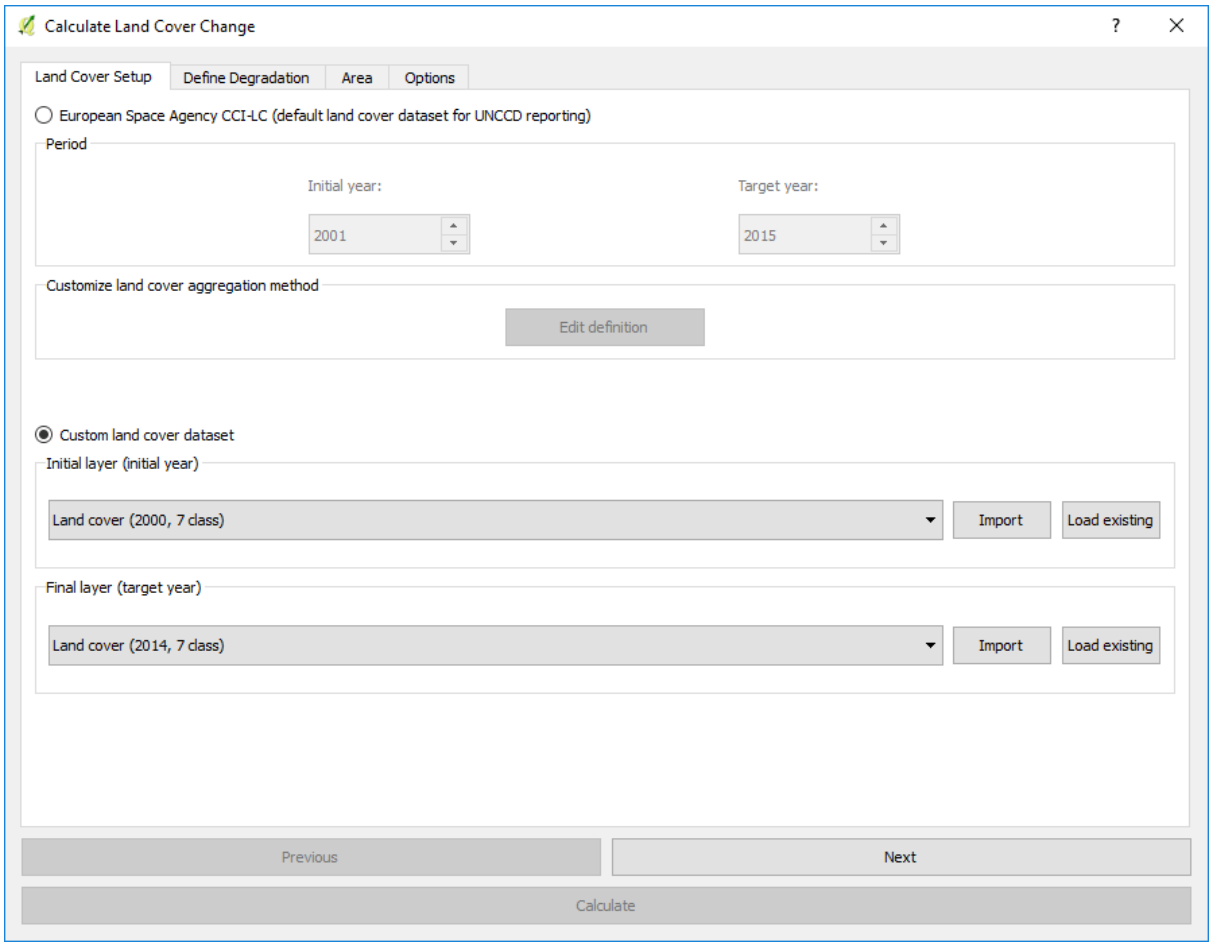
13. Now that both land cover datasets have been imported into Trends.Earth, the land cover change analysis tool needs to be run. Search for the Trends.Earth toolbar within QGIS, and click on the Calculate icon ( ).



14. The Calculate Indicators menu will open. In that window, click on Land cover button found under Step 1 - Option 2.



15. The Calculate Land Cover Change window will open. In the Setup tab, click on Custom land cover dataset. Use the drop down option next to Initial layer (initial year) and Final layer (target year) to change the dates accordingly. When done, click Next.

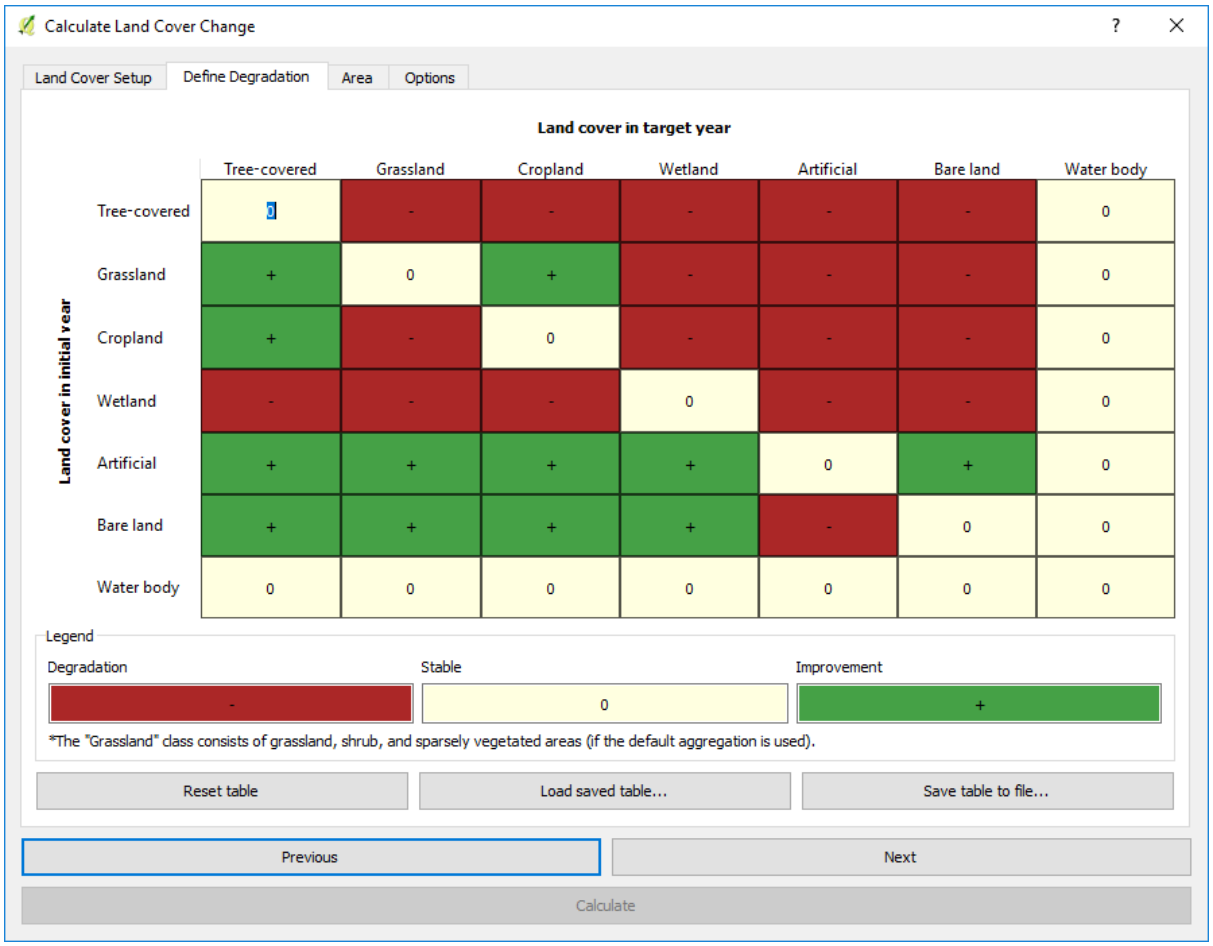


16. The Define Degradation tab is where you define the meaning of each land cover transition in terms of degradation. Transitions indicated in red (minus sign) will be identified as degradation in the final output, transitions in beige (zero) will be identified as stable, and transitions in green (plus sign) will be identified as improvements.

    For example, by default it is considered that a pixel that changed from Grassland to Tree-covered will be considered as improved. However, if in your study area woody plant encroachment is a degradation process, that transition should be changed for that particular study area to degradation (minus sign).

    If you have made no changes to the default matrix, simply click Next.

    If you did change the meaning of some of the transitions, click on Save table to file... to save the definition for later use. Then click Next.



17. In the Area tab define the area of analysis. There are two options:

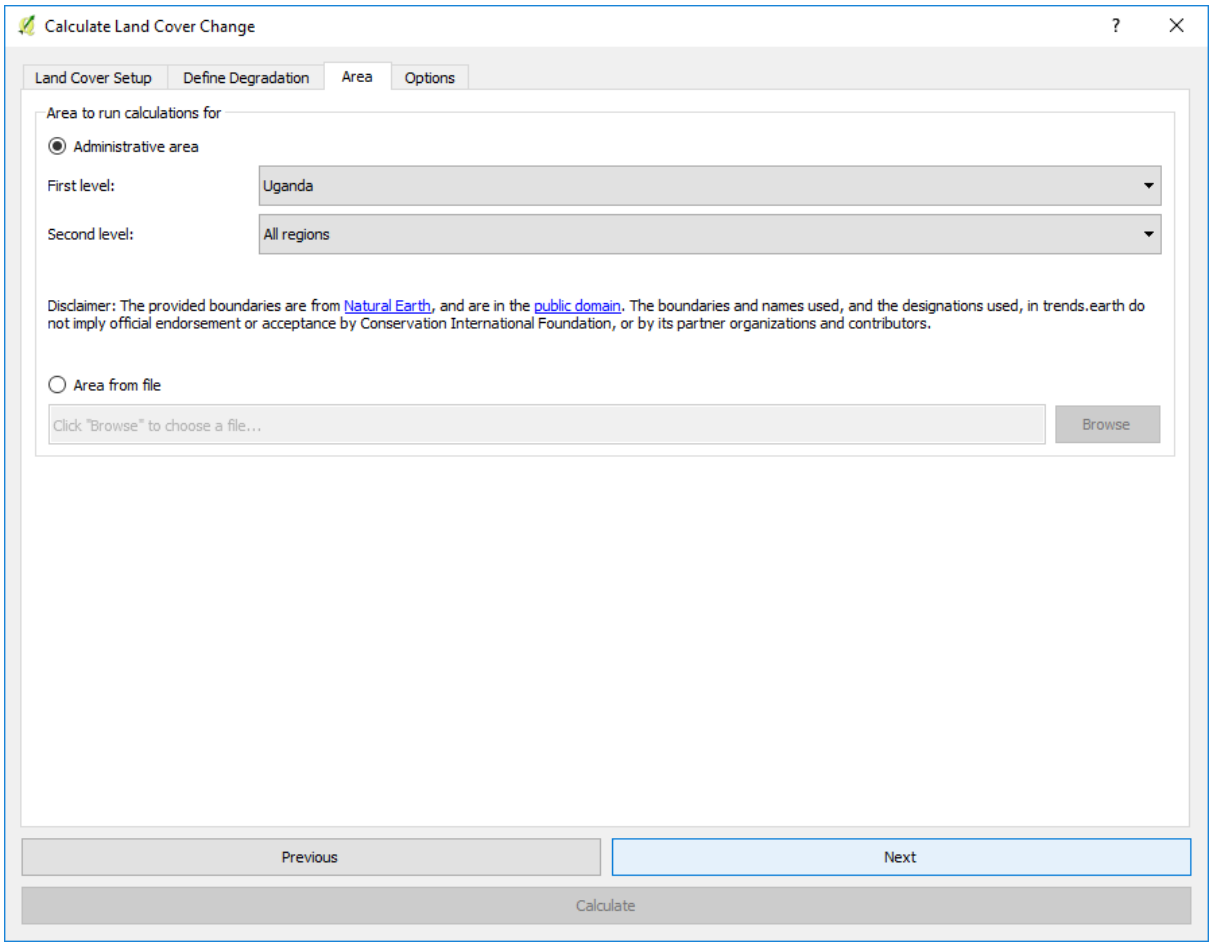
- Use provided country and state boundaries: If you want to use this option make sure the Administrative area option is highlighted, and then select the First Level (country) or Second Level (state or province depending on the country).

Note: The Natural Earth Administrative Boundaries provided in Trends.Earth, are in the public domain. The boundaries and names used, and the designations used, in Trends.Earth do not imply official endorsement or acceptance by Conservation International Foundation, or by its partner organizations and contributors.

If using Trends.Earth for official purposes, it is recommended that users choose an official boundary provided by the designated office of their country.

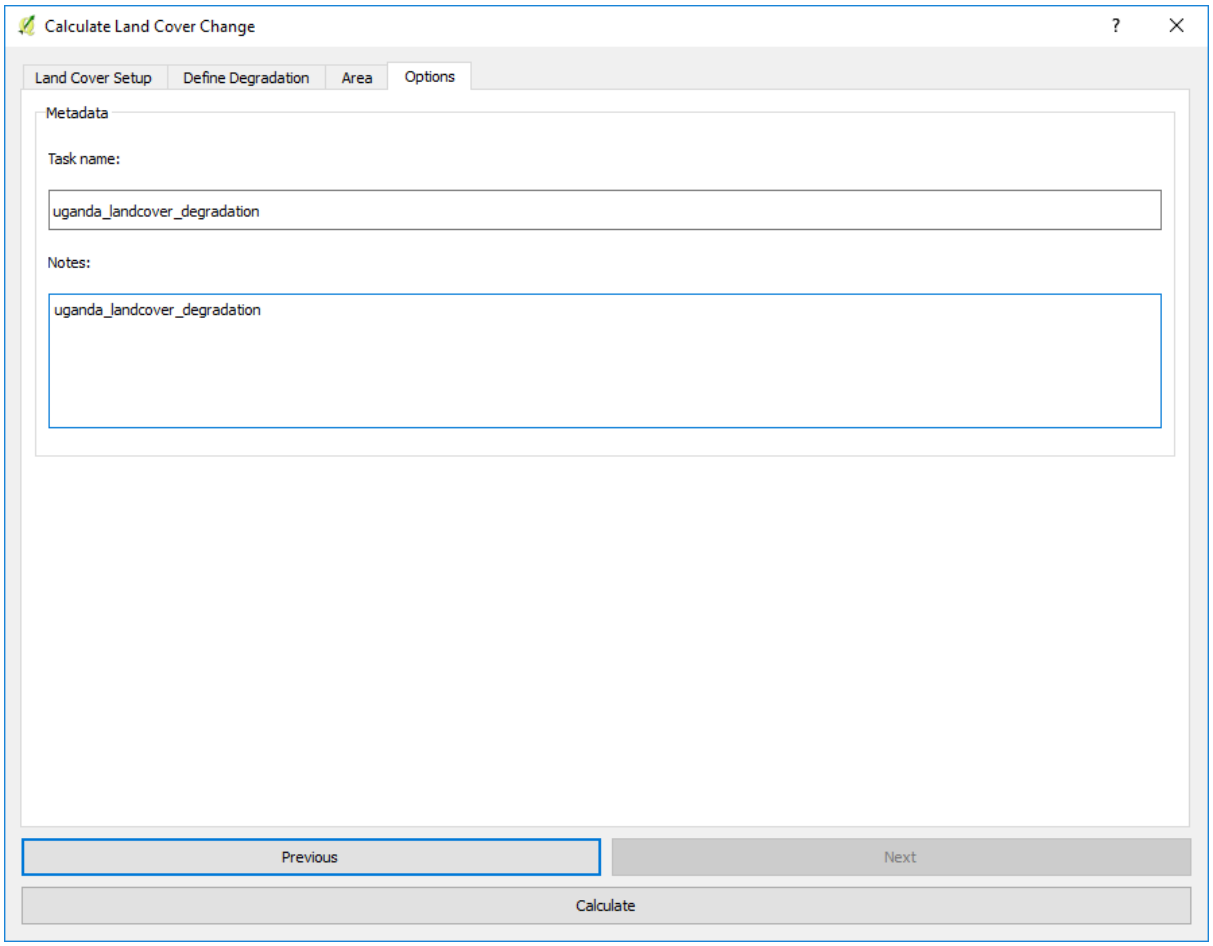
- Use your own area file: If you want to use your own area of analysis, make sure the Area from file option is highlighted. Then click Browse and navigate to the folder in your computer where you have the file stored.

When you have selected the area for which you want to compute the indicators, click Next.

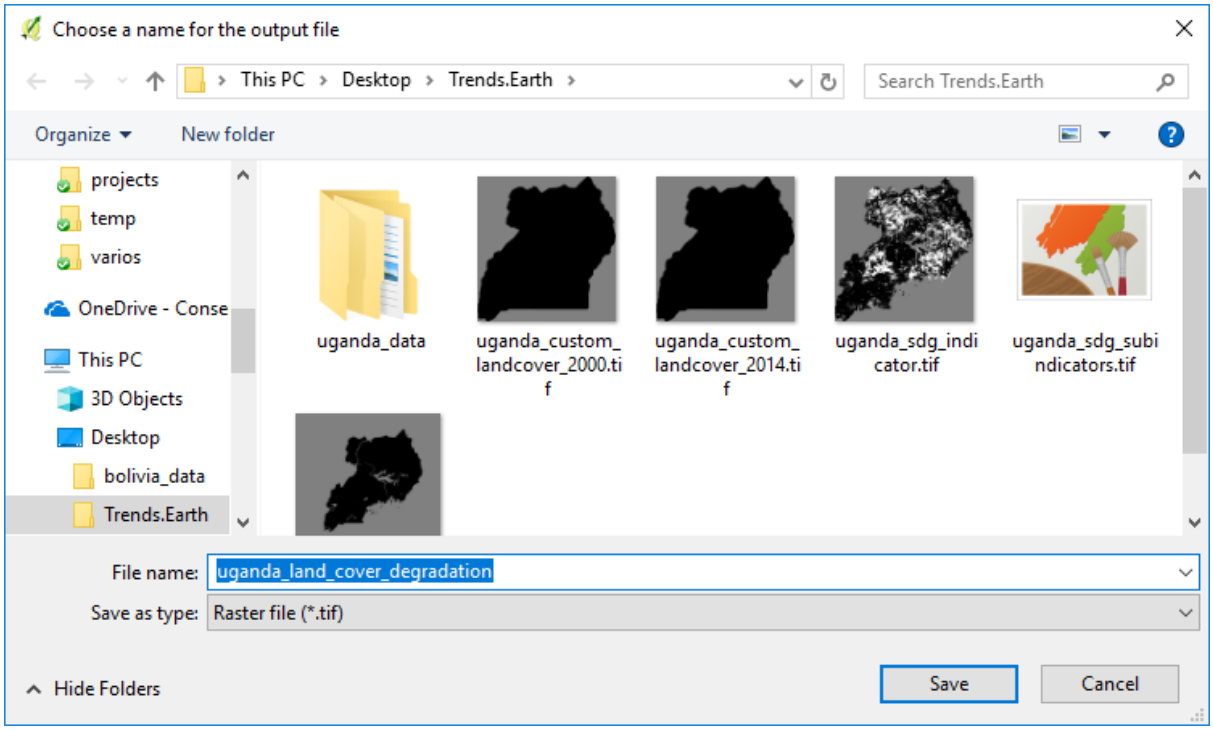


18. In the Options tab you can define the Task name and make some Notes to identify the analysis you are running. What information to indicate is optional, but we suggest noting:

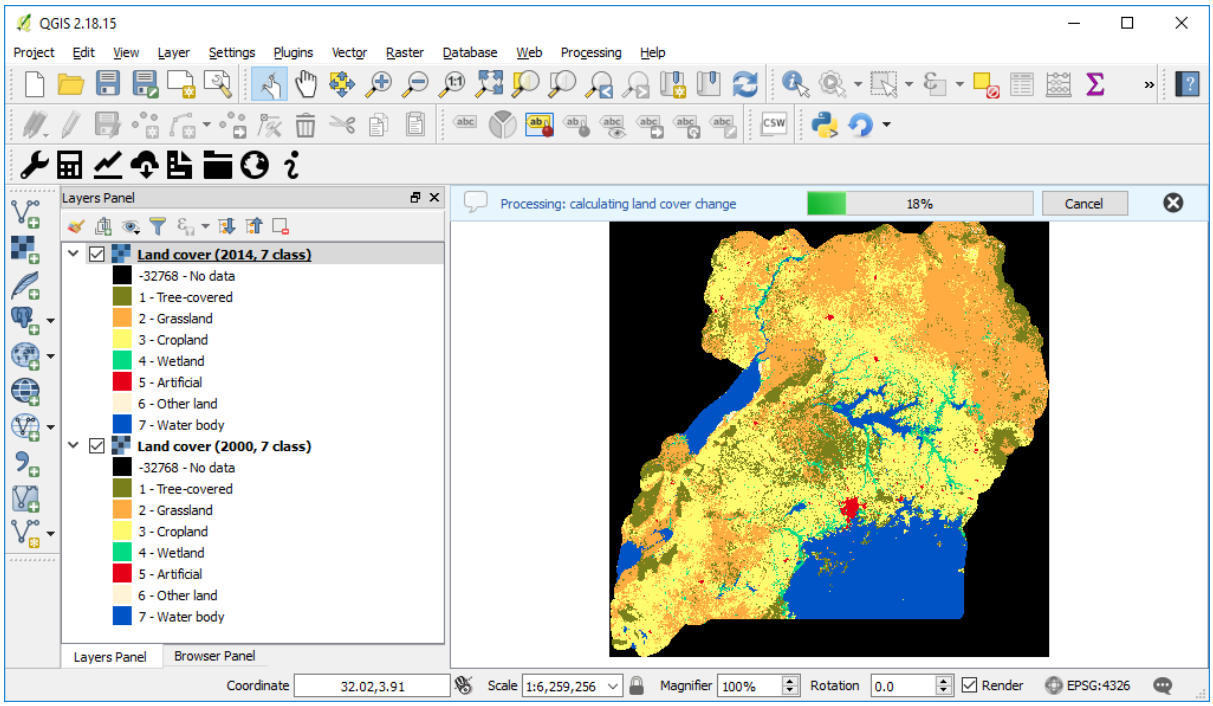
- Area of analysis
- Dates
- Indicators run



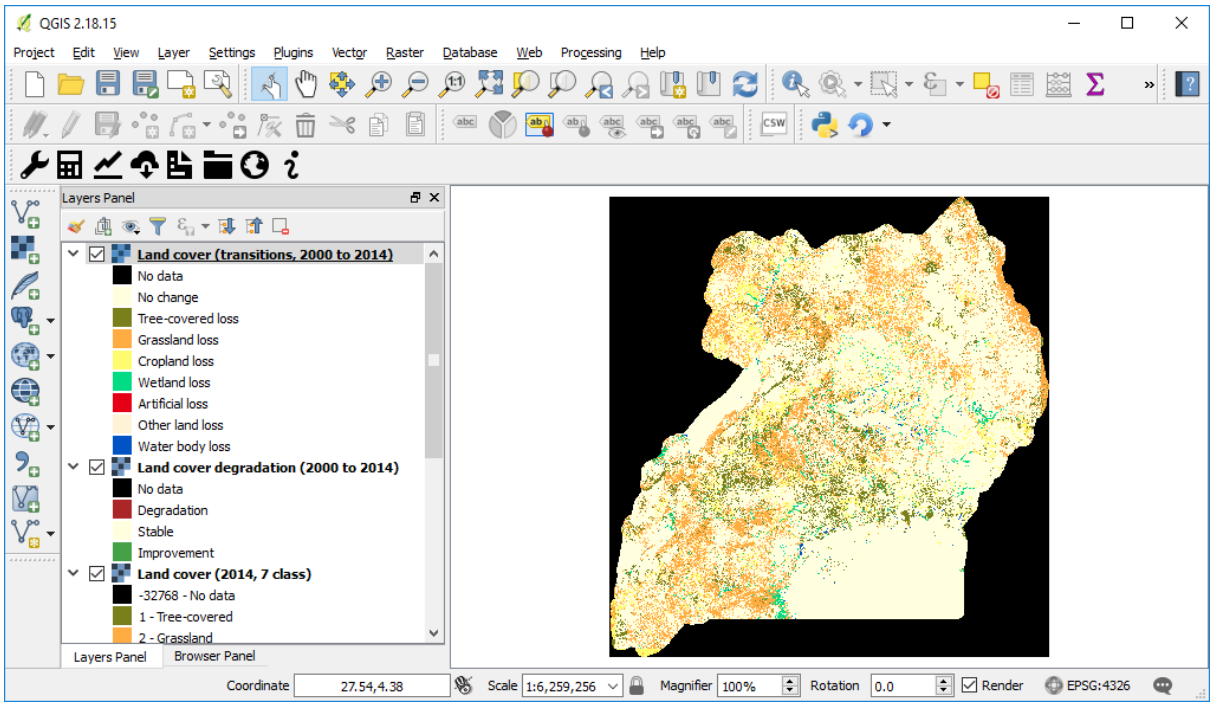
19. When you click Calculate, the Coose a name for the output file will open. Select where to save the file and its name, and click Save.



20. A progress bar will appear showing the percentage of the task completed.



21. When the processing is completed, the imported land cover degradation sub-indicator dataset will be loaded to QGIS.



Note: Refer to the Compute SDG indicator tutorial for instructions on how to use the land cover sub-indicator to compute the final SDG 15.3.1 after integration with changes land productivity and soil organic carbon.

CHAPTER 21

Use custom soil data

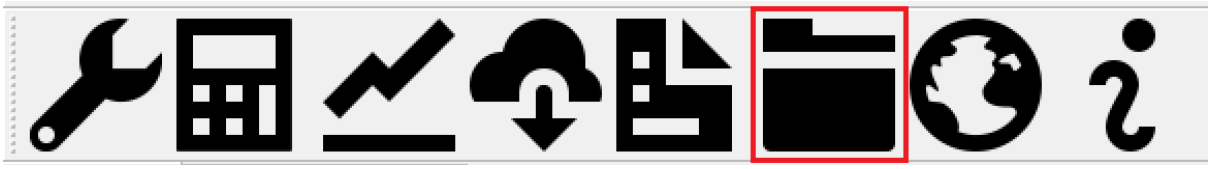
- Objective: Learn how to load custom soil organic carbon data to compute the carbon change sub-indicator using Trends.Earth.
- Estimated time of completion: 20 minutes
- Internet access: Not required

Note: Download this page as a PDF for offline use

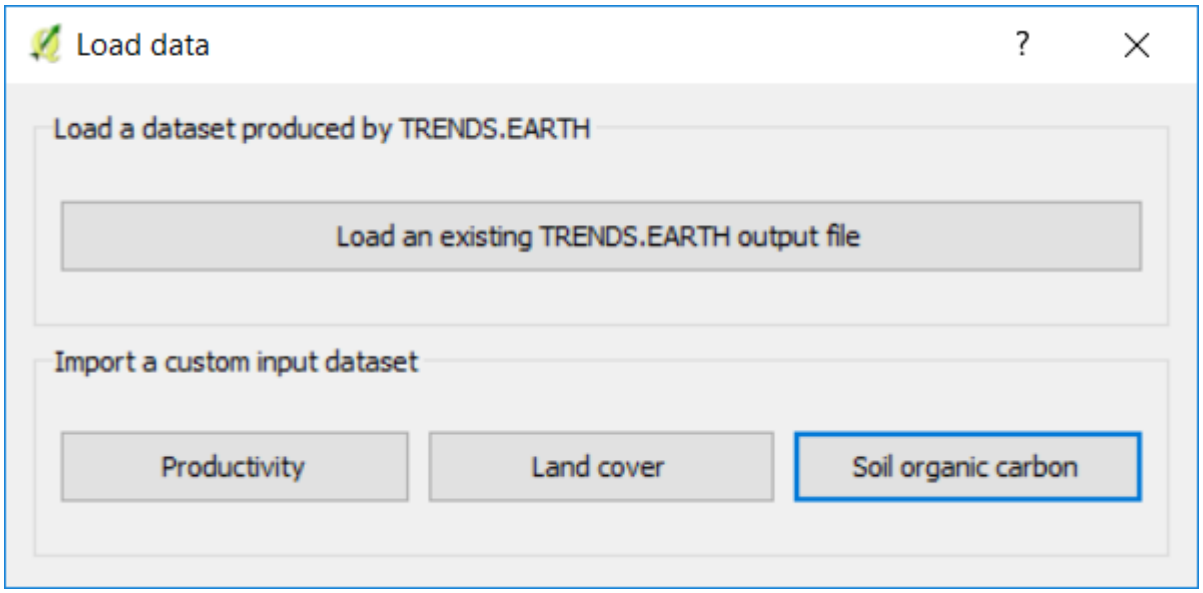
21.1 Loading custom soil organic carbon data

Note: This tool assumes that the units of the raster layer to be imported are Metrics Tons of organic carbon per hectare. If your layer is in different units, please make the necessary conversions before using it in Trends.Earth.

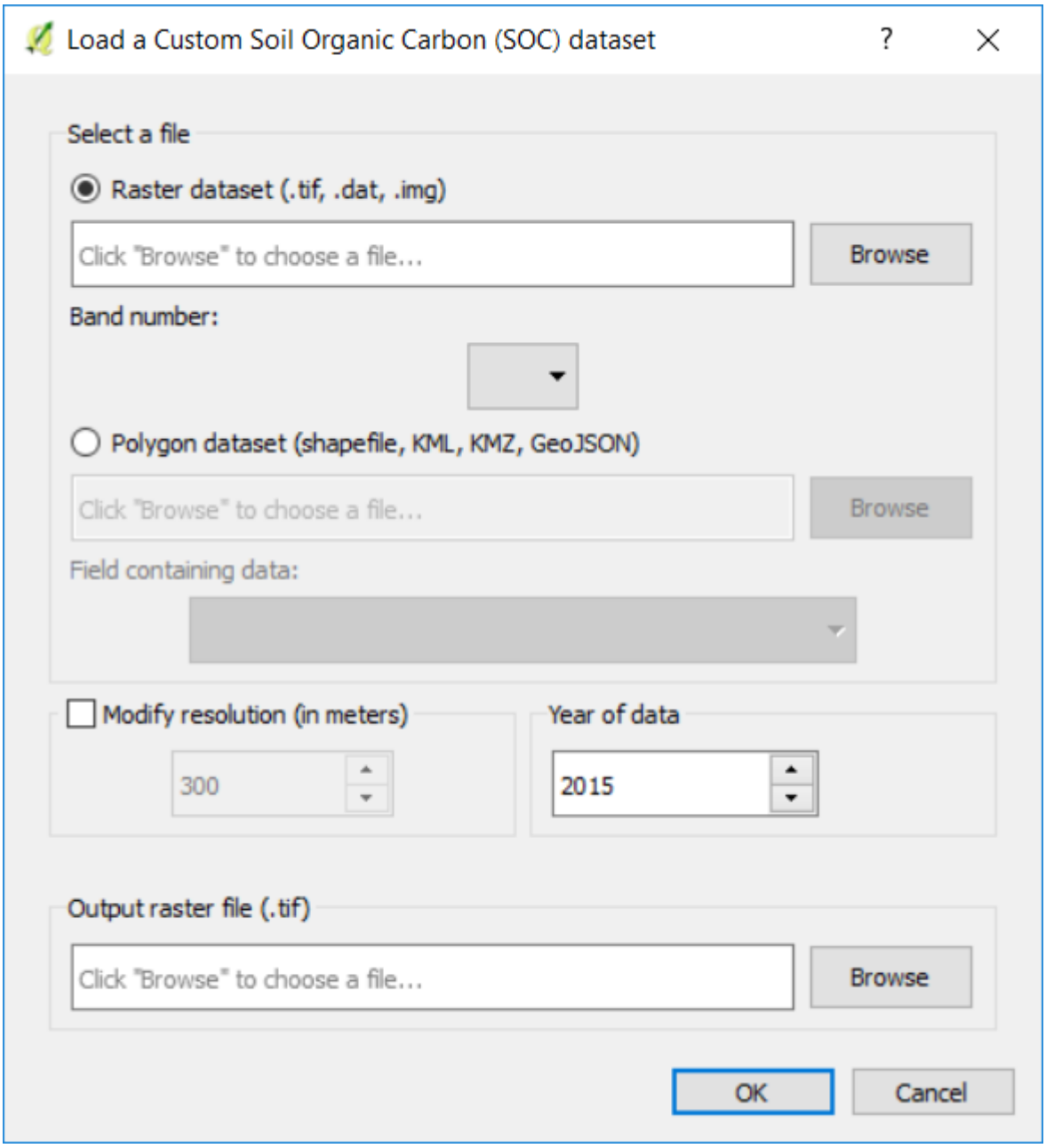
1. To load soil organic carbon data click on the ( ) icon in the Trends.Earth toolbar.



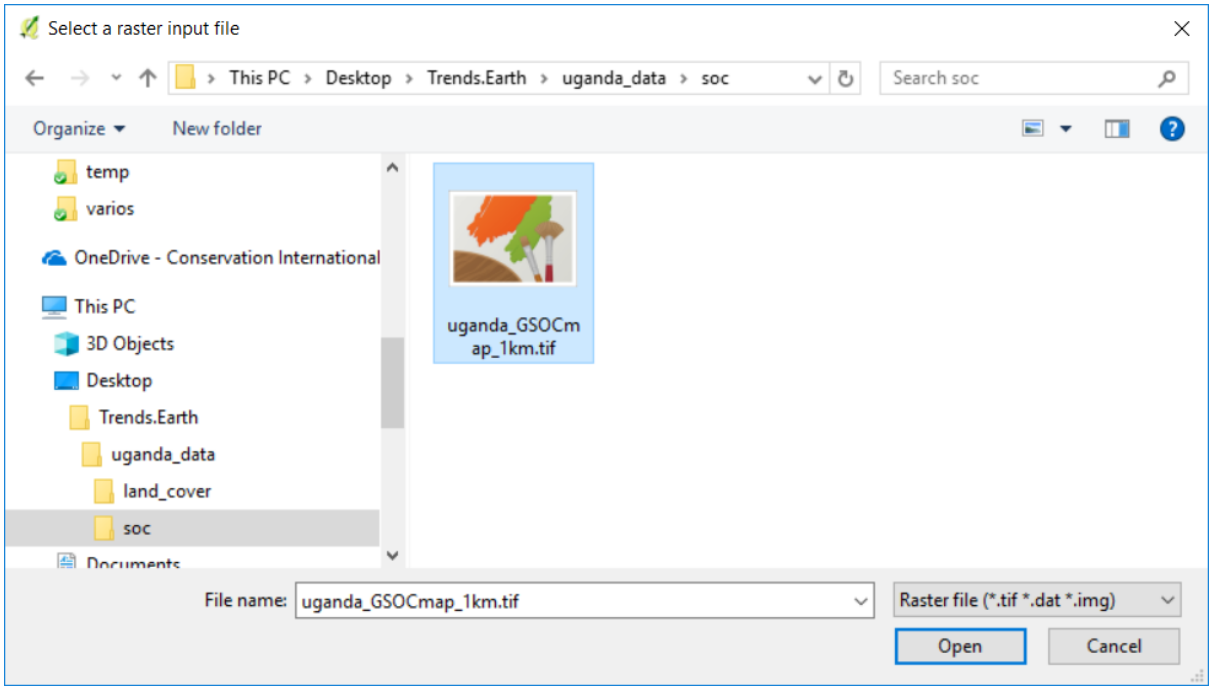
2. The Load data menu will open. Select Soil organic carbon from the Import a custom input dataset section.



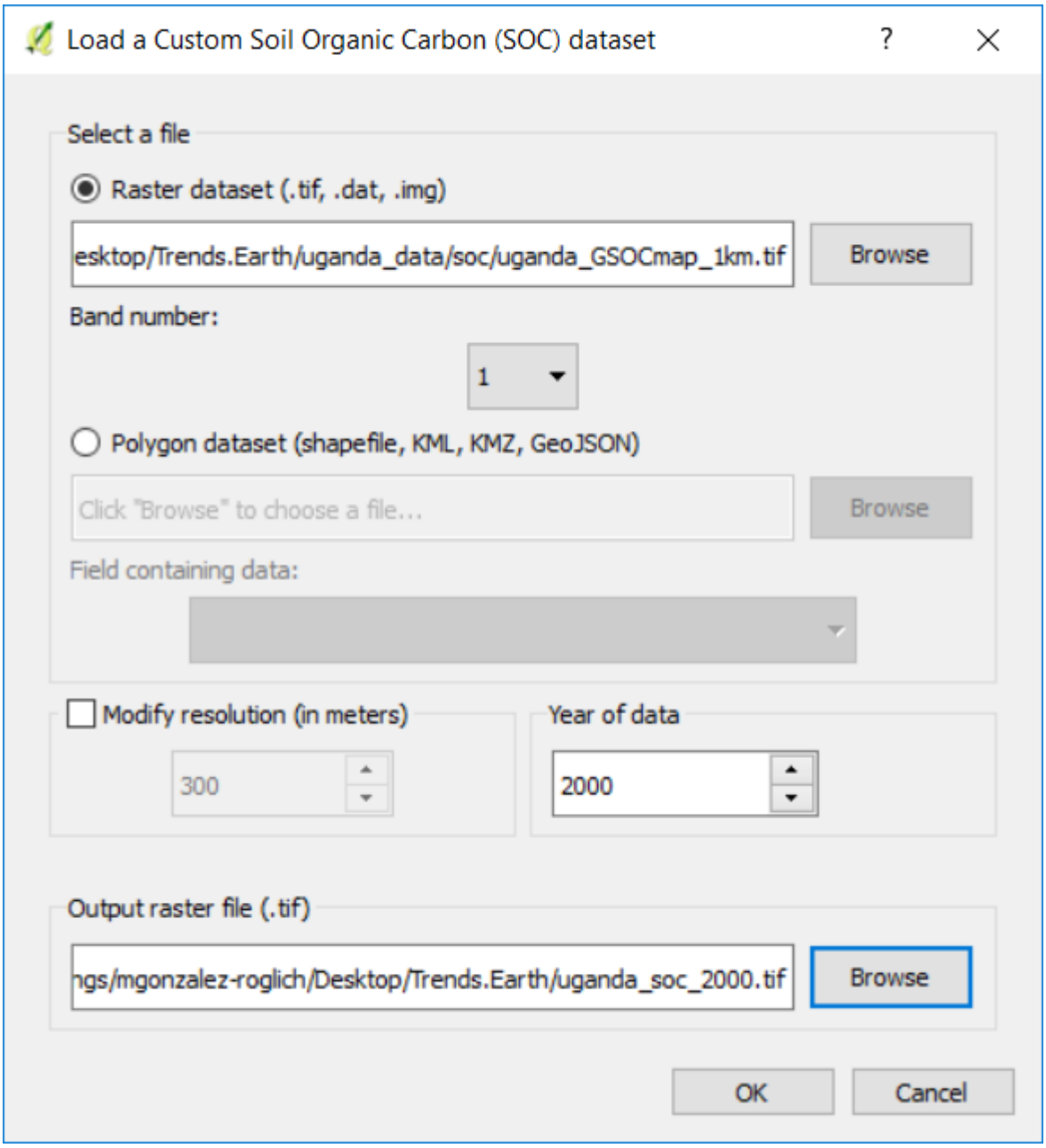
3. In the Load a Custom Soil Organic Carbon (SOC) dataset use the radio button to select the format of the input file (raster or vector). For this tutorial select raster, since the data distributed by the UNCCD is in raster format. Click on Browse to navigate to the soil organic carbon file you wish to import.



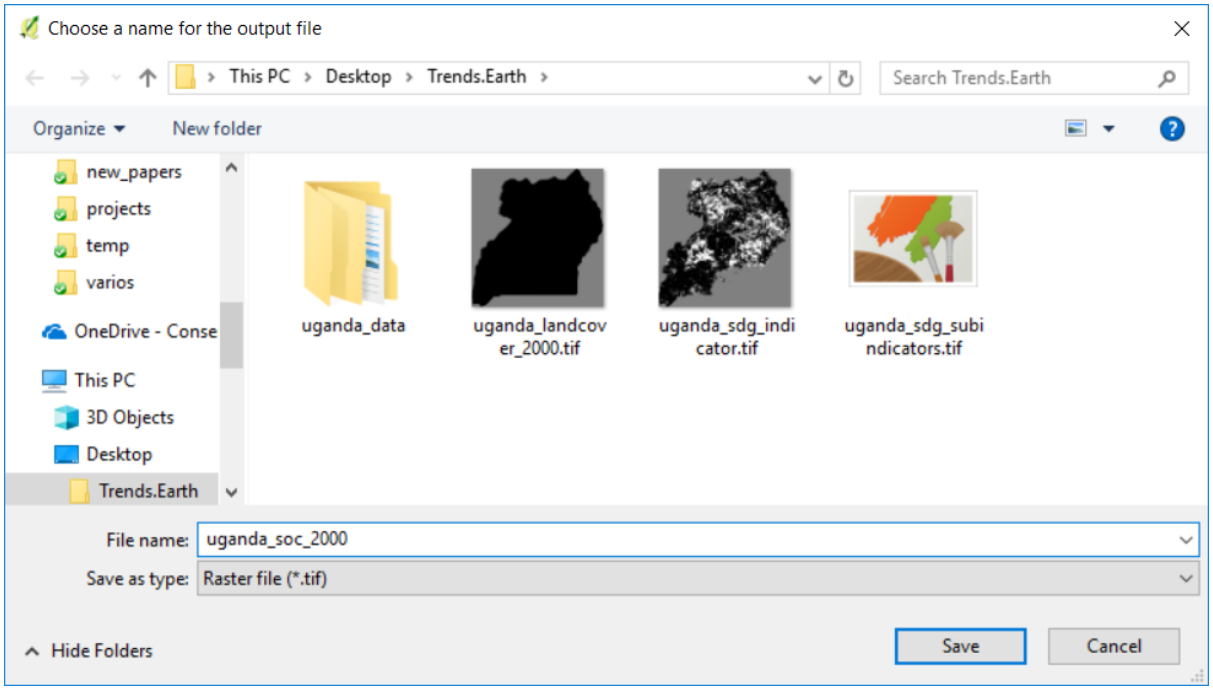
4. Use the Select input file window to navigate to the file to be imported, select it, and click Open.



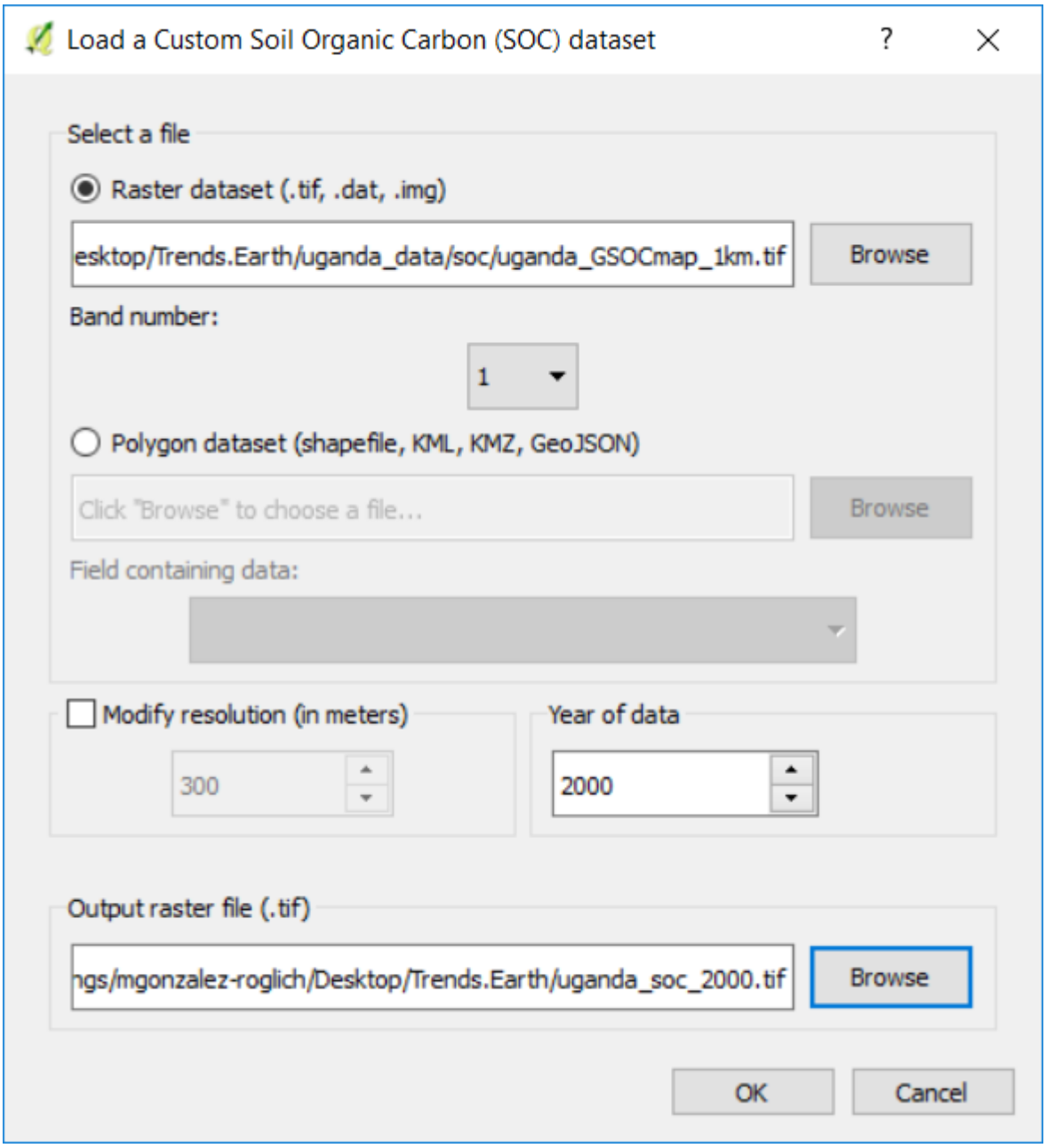
5. Back at the Load a Custom Soil Organic Carbon (SOC) dataset window you have options for selecting the band number in which the productivity data is stored, in case your input file is a multi band raster. You also have the option of modifying the resolution of the file. We recommend leaving those as defaults unless you have valid reasons for changing them.
6. Define the year of reference for the data. In this case, we will assume the soil organic carbon data is from 2000, but if using local data, make sure you are assigning the correct year.
7. Click Browse at the bottom of the window to select the Output raster file.



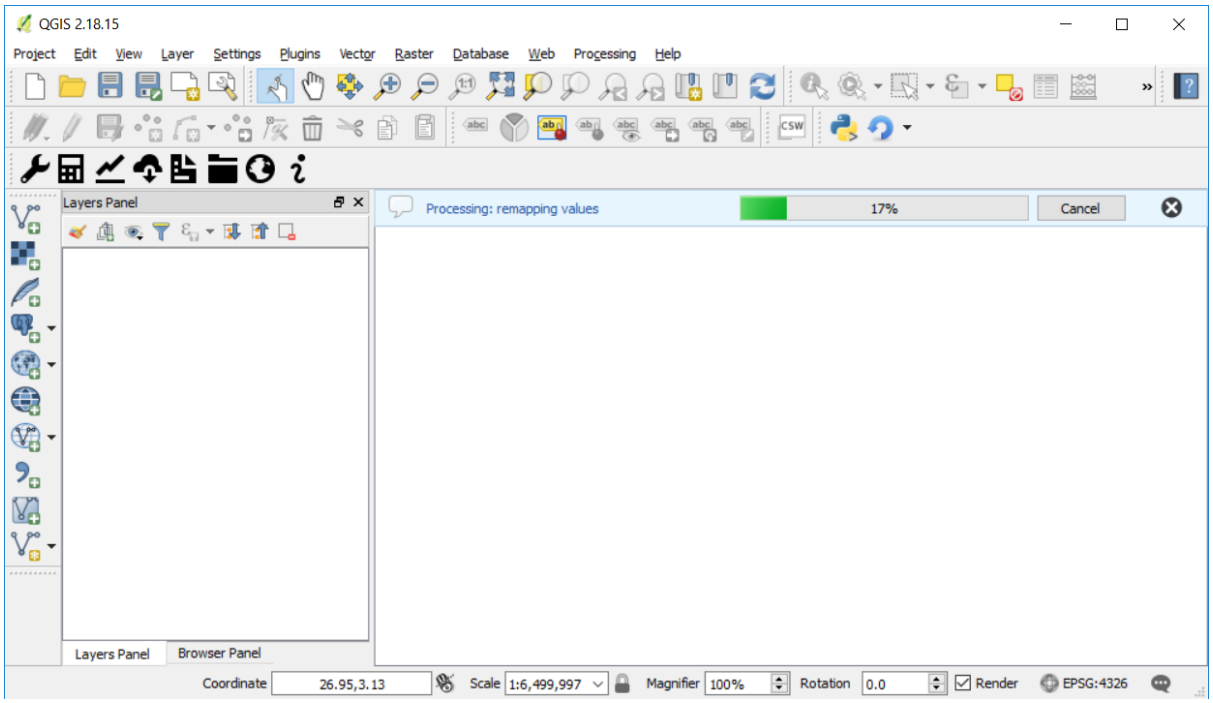
8. Navigate to the folder where you want to save the file. Assign it a name and click Save.



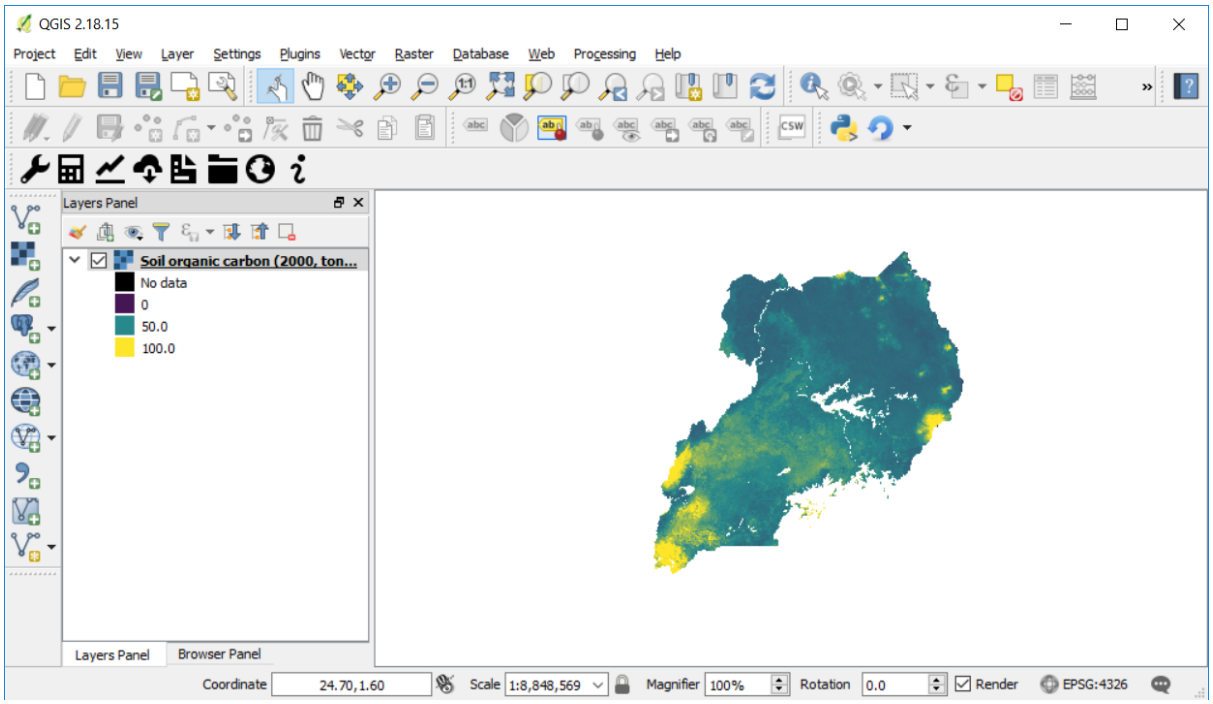
9. Back at the Load a Custom Soil Organic Carbon (SOC) dataset click OK for the tool to run.



10. A progress bar will appear showing the percentage of the task completed.



11. When the processing is completed, the imported soil organic carbon dataset will be loaded to QGIS.



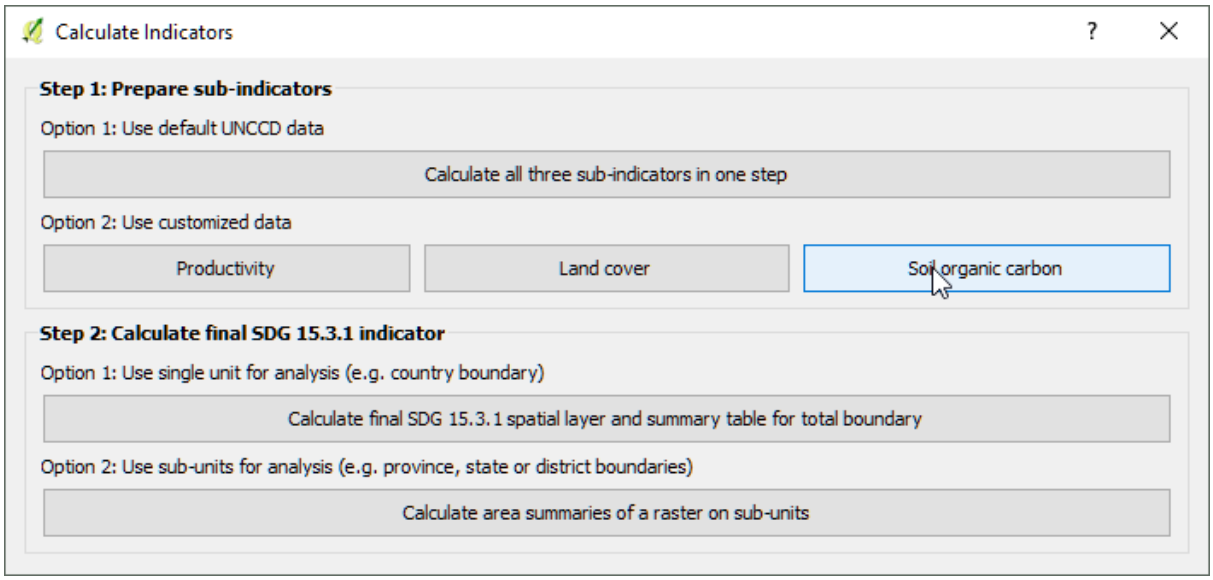
21.2 Calculating soil organic carbon with custom data

Once you have imported a custom soil organic carbon dataset, it is possible to calculate soil organic carbon degradation from that data. To do so, first ensure the custom soil organic carbon data is loaded within QGIS (see Loading custom soil organic carbon data).

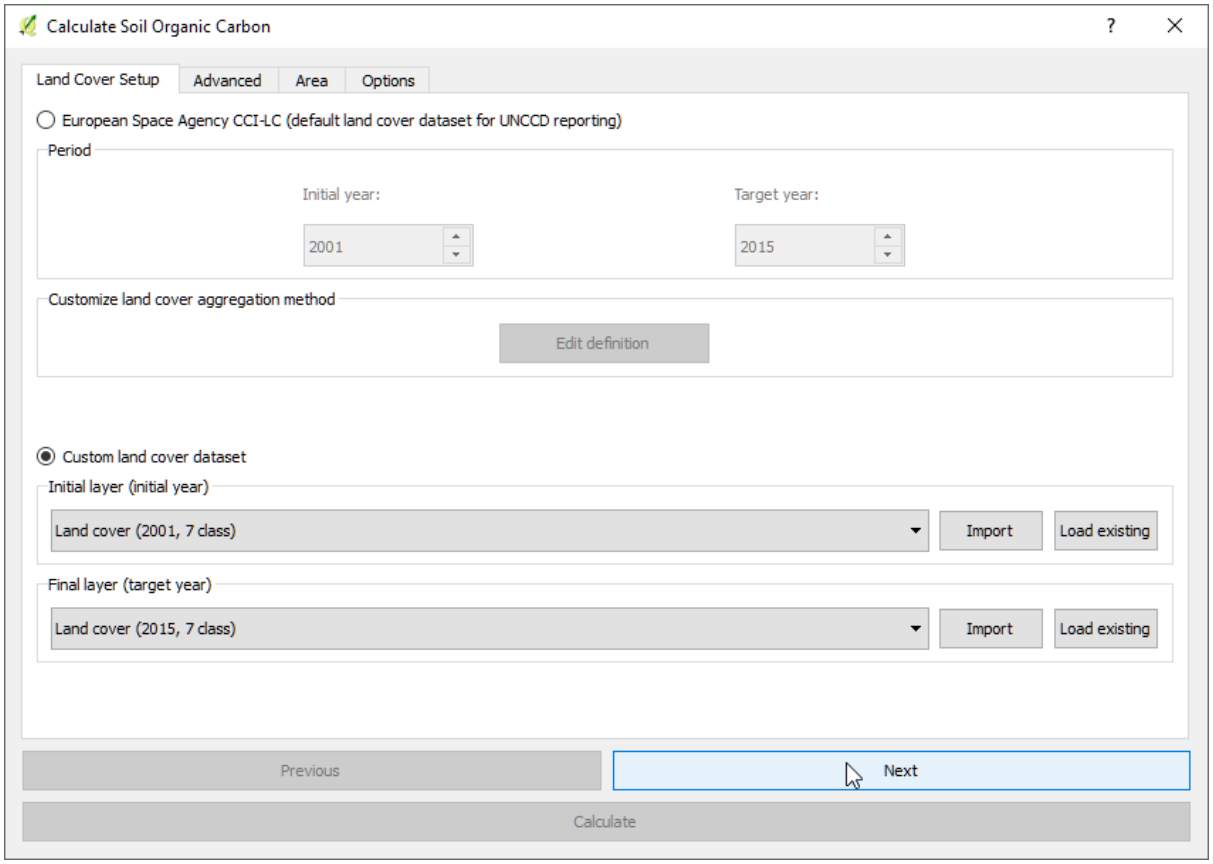
1. To calculate soil organic carbon degradation from custom data, first click on the ( ) icon on the Trends.Earth toolbar:



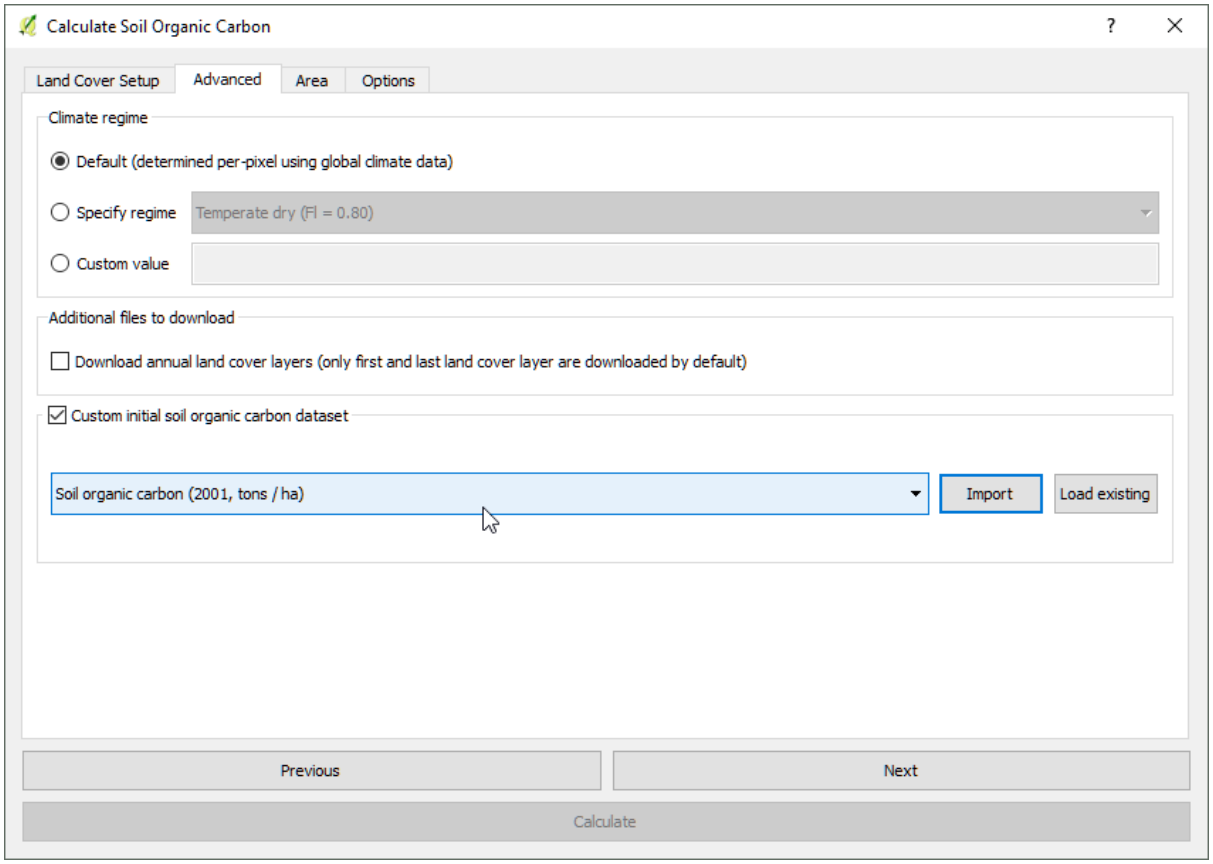
1. The “Calculate indicators” menu will open. Select “Soil organic carbon” from the “Option 2: Use customized data” section.



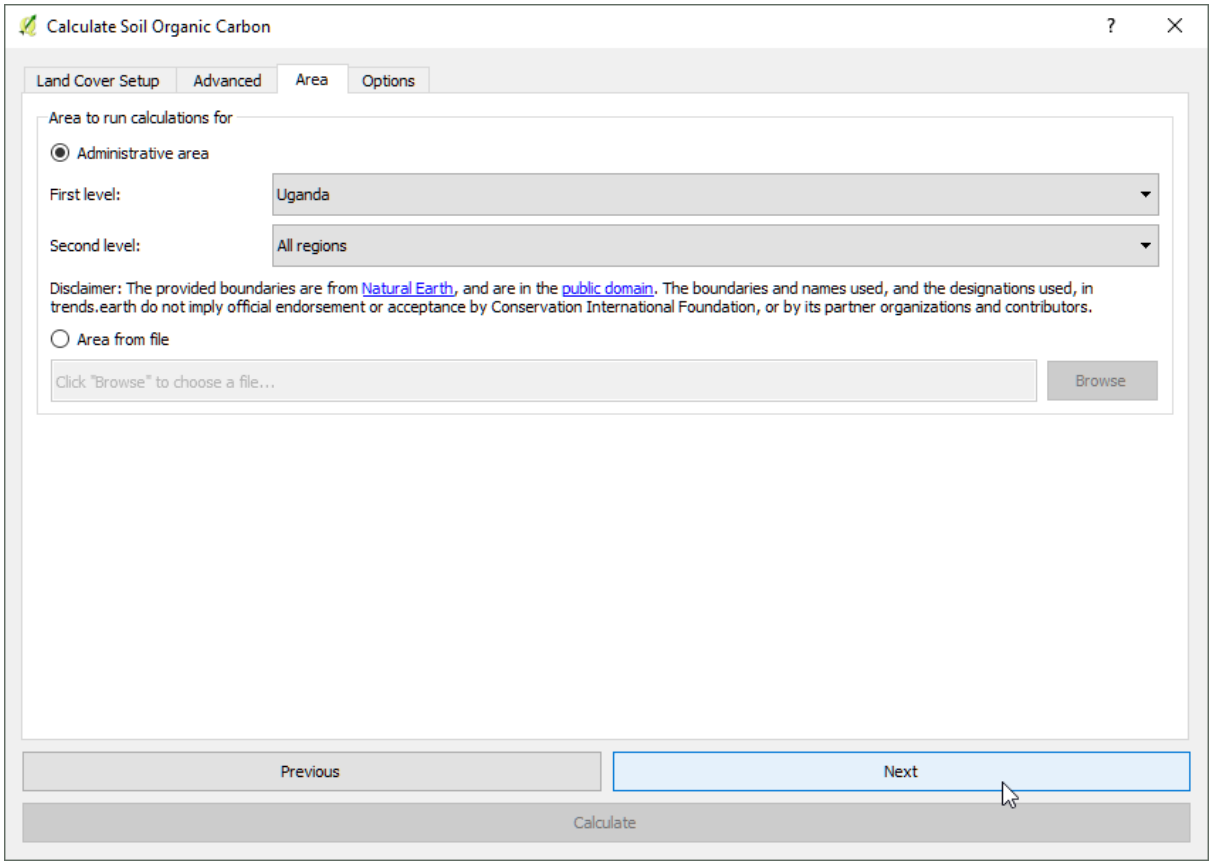
1. The “Calculate Soil Organic Carbon” window will open. Click the radio button next to “Custom land cover dataset” and select either “Import” to import a custom land cover dataset, or “Load existing” to load a land cover dataset you have already processed in Trends.Earth. Be sure to select both an “Initial layer” and a “Final layer”. See the Use custom land cover data tutorial for more information on loading land cover datasets. Once you have selected both datasets, click next:



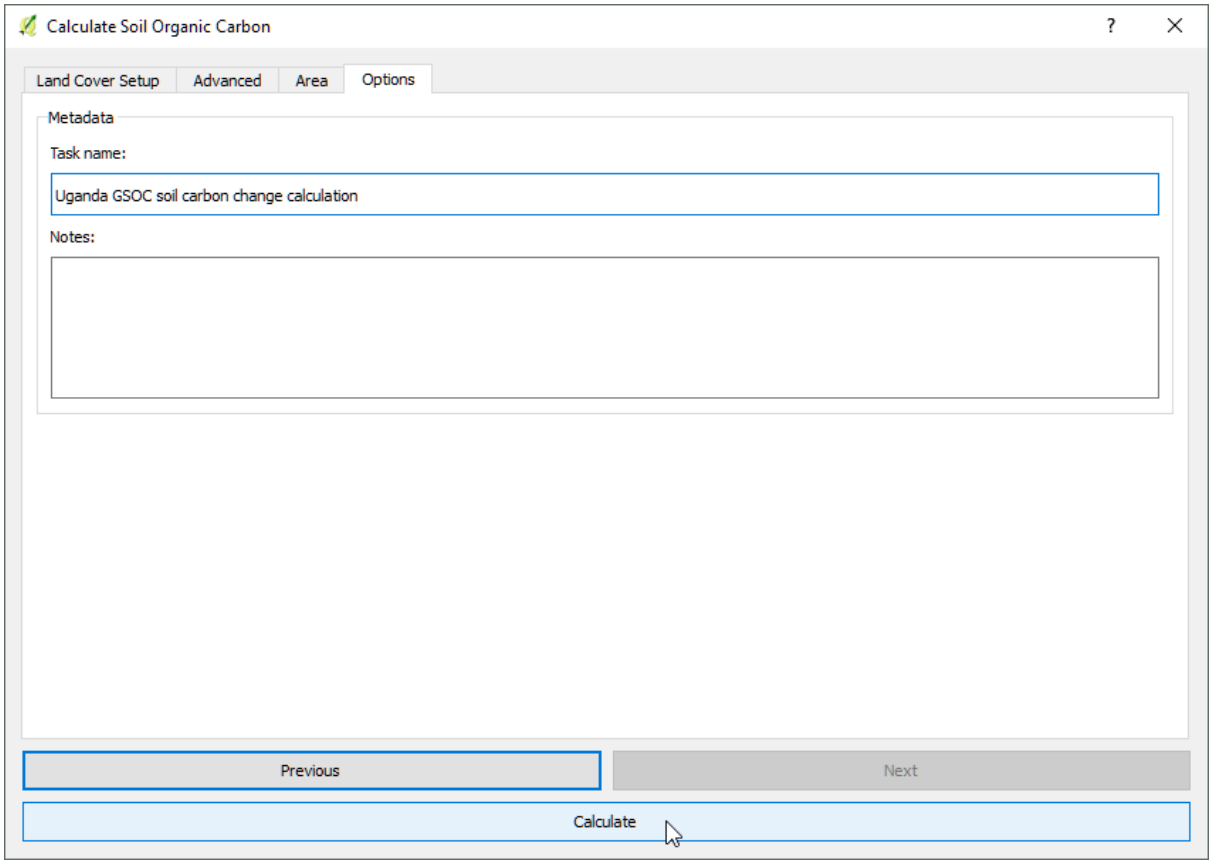
1. On the next screen, click the check box next to "Custom initial soil organic carbon dataset", and then use the "Import" or "Load existing" buttons to either import custom soil carbon layer (Loading custom soil organic carbon data) or to load an existing one that has already been calculated:



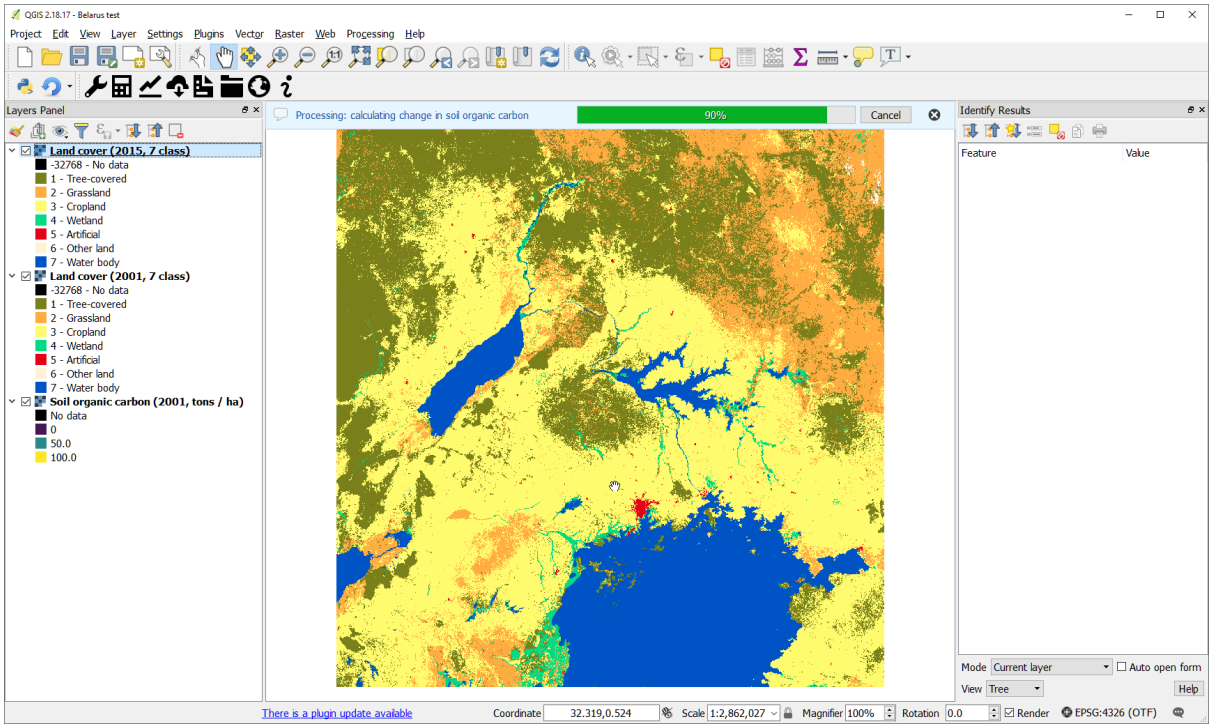
1. Click “Next”. Now, choose the area you wish to run calculations for:



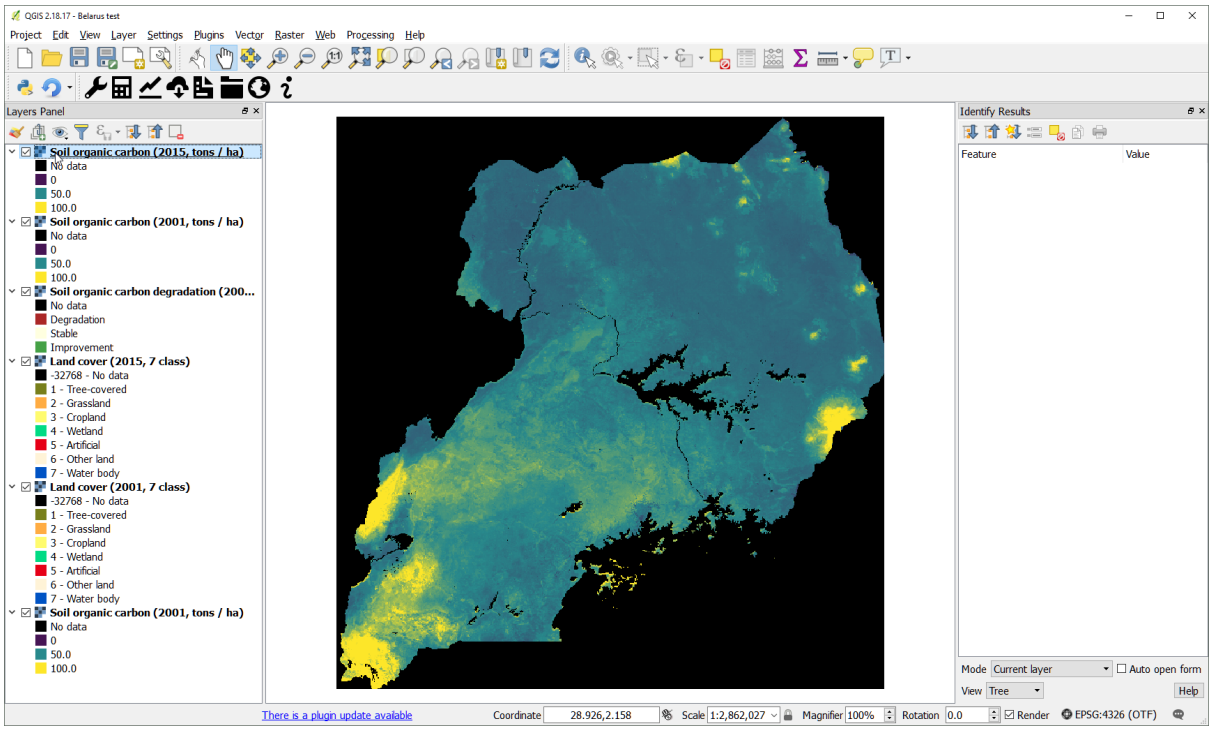
1. Click “Next”. on the last screen, enter a task name or any notes you might wish to save (this is optional) and then click “Calculate”:



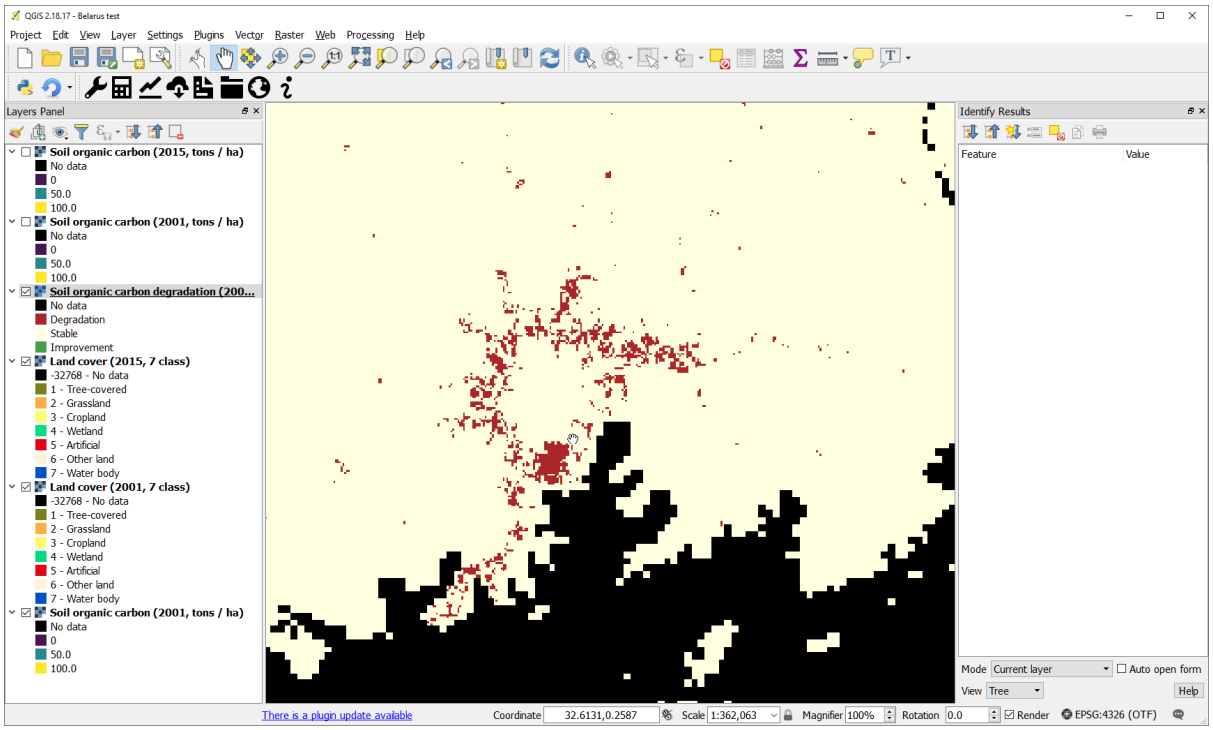
1. A progress bar will appear on your screen. Do not quit QGIS or turn off your computer until the calculation is complete.



1. Once the calculation is complete, three layers will load onto your map: 1) the final soil organic carbon layer, 2) the initial soil organic carbon layer, and 3) the soil organic carbon degradation layer:



1. For example, we can see areas of degradation in soil carbon around Kampala:



Note: Refer to the Compute SDG indicator tutorial for instructions on how to use the imported soil organic carbon data to compute the final SDG 15.3.1 after integration with land cover and land productivity.

CHAPTER 22

Load results and basemap

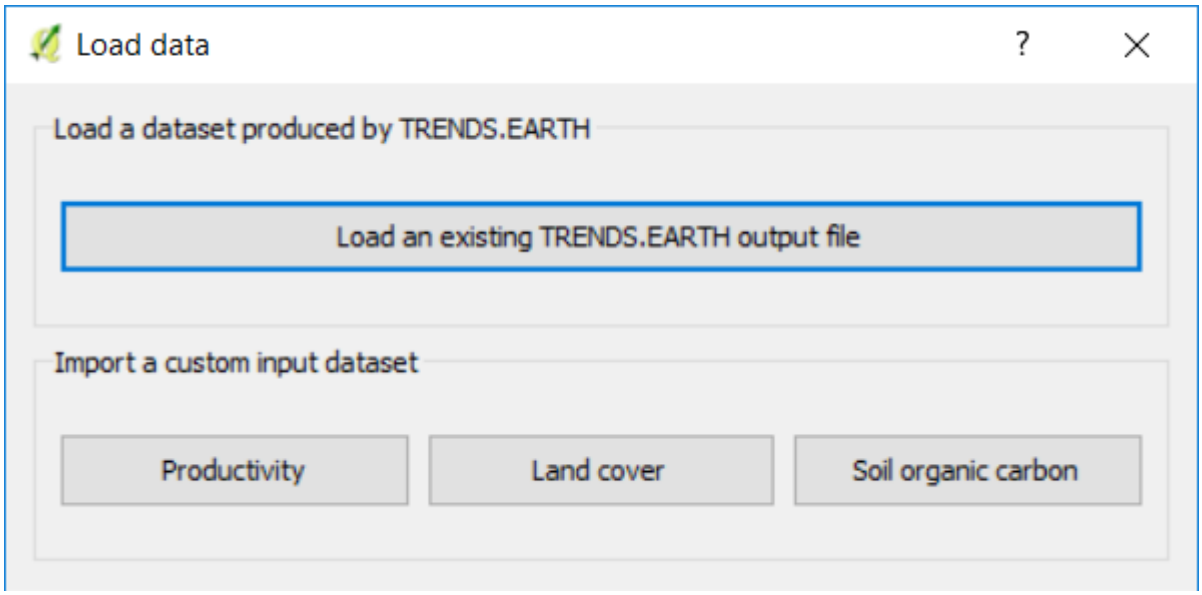
- Objective: Learn how to load into QGIS results from previous analysis run on Trends.Earth, and how to load a base map to make help with the interpretation of spatial patterns displayed by the indicators.
- Estimated time of completion: 15 minutes
- Internet access: Required only the first time you load a base map, since the information needs to be downloaded. Once the data is stored in your computer base maps can be loaded without Internet access.

Note: Download this page as a PDF for offline use

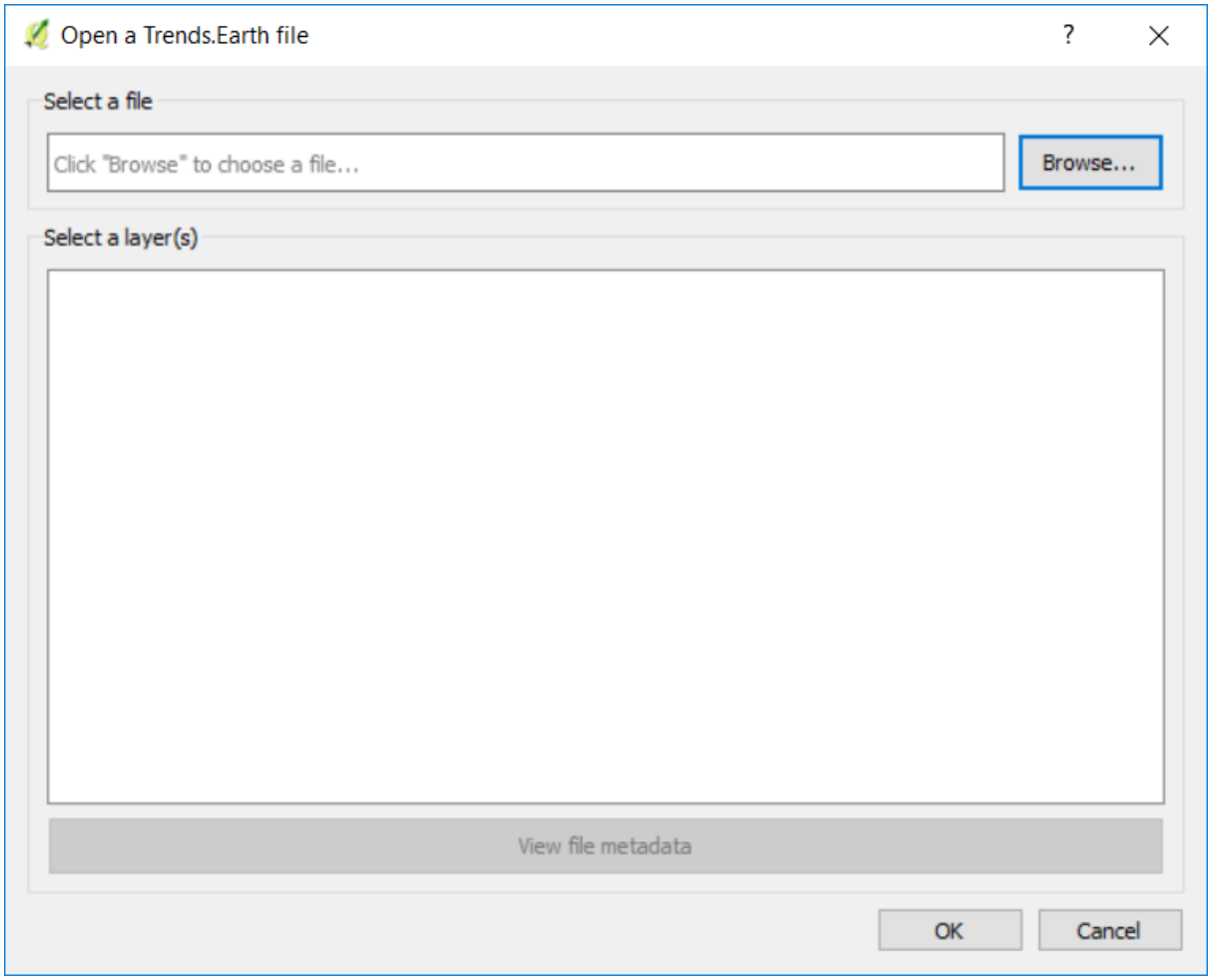
1. To load results from previous Trends.Earth analysis into QGIS click on the ( ) icon in the Trends.Earth toolbar.



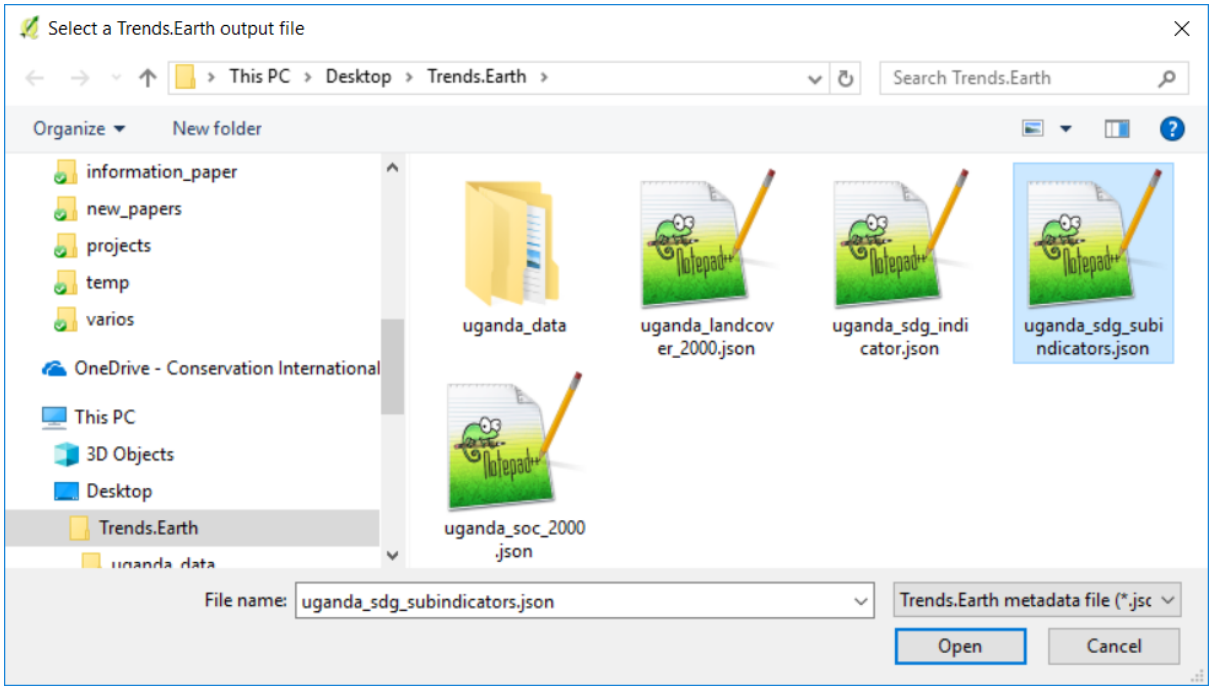
2. The Load data menu will open. Select Load and existing TRENDS.EARTH output file from the Load a dataset produced by TRENDS.EARTH section.



3. Click the Browse button on the Open a Trends.Earth file window.



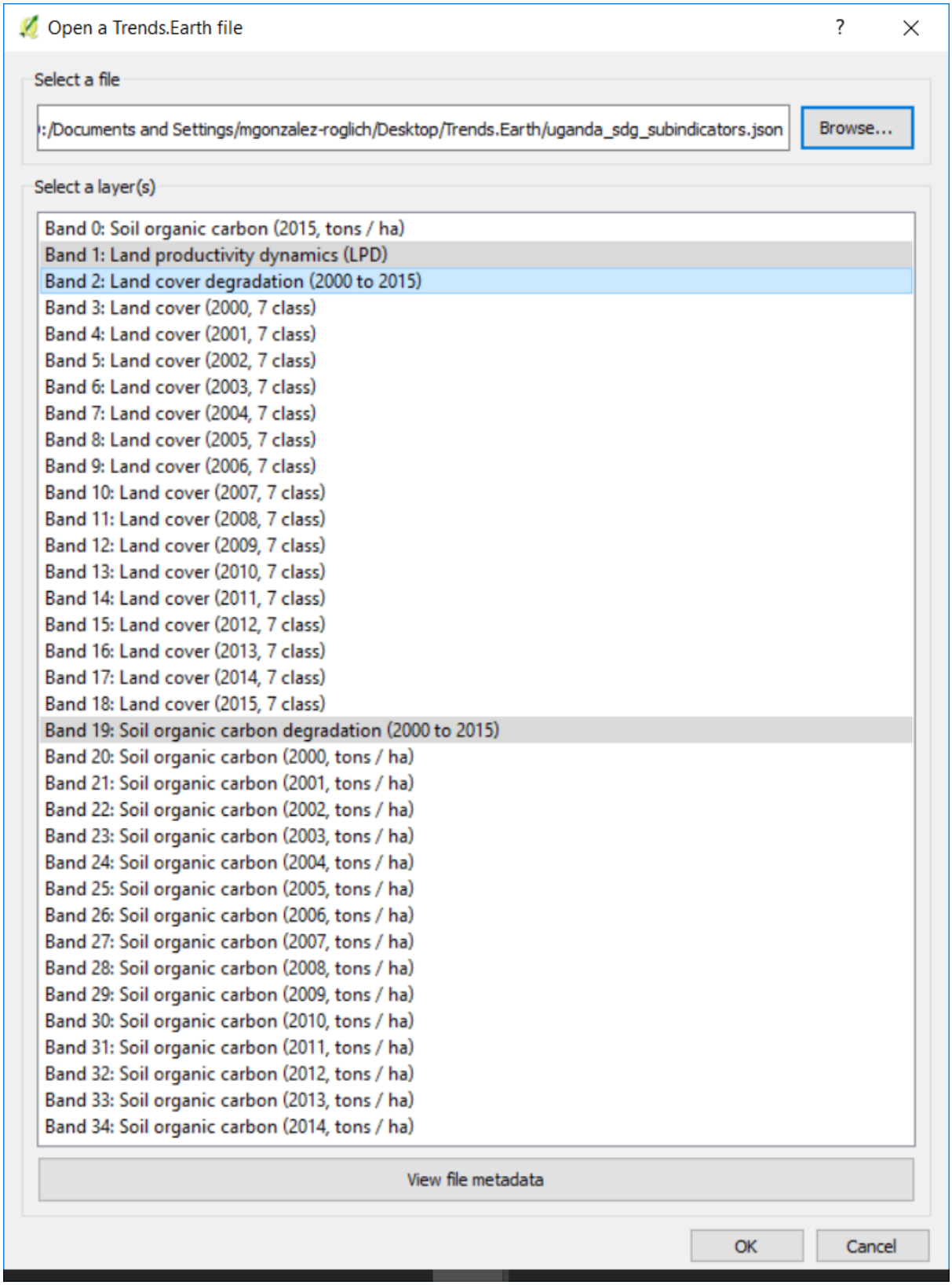
3. On the Select a Trends.Earth output file window navigate to the folder where you stored the data and select the file to load, and click Open.



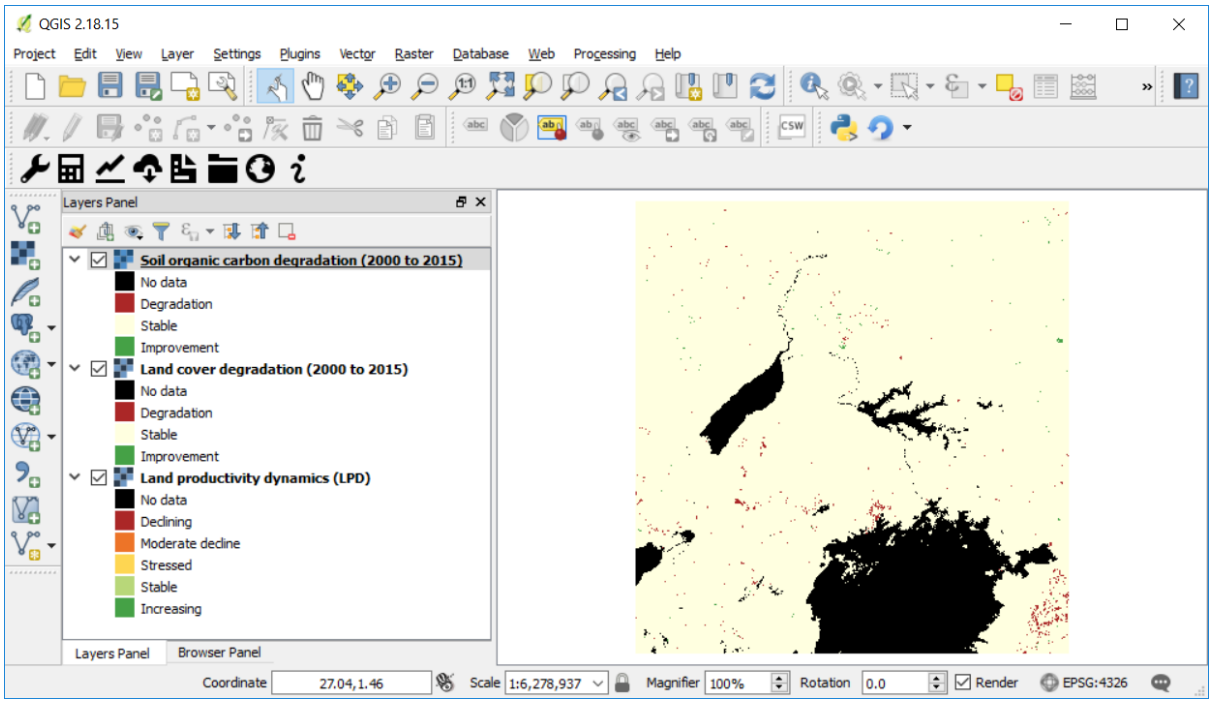
4. You will be back at the Open a Trends.Earth file window, but this time you will see many layers listed under the Select a layer(s) section. Each of those options is a band in the raster file you downloaded from Trends.Earth. The number of bands and specific information in each of them will vary, but in any case, this tool will show you information to allow you to decide which layers to display.

In this case, since this layer is the result of the 1-step analysis (Compute SDG indicator), the file contains information for land productivity, land cover and soil organic carbon.

If you only want to see the final layer for each of the sub-indicators, simply leave the default selection and click OK.



5. The selected layers will be displayed on the QGIS map.



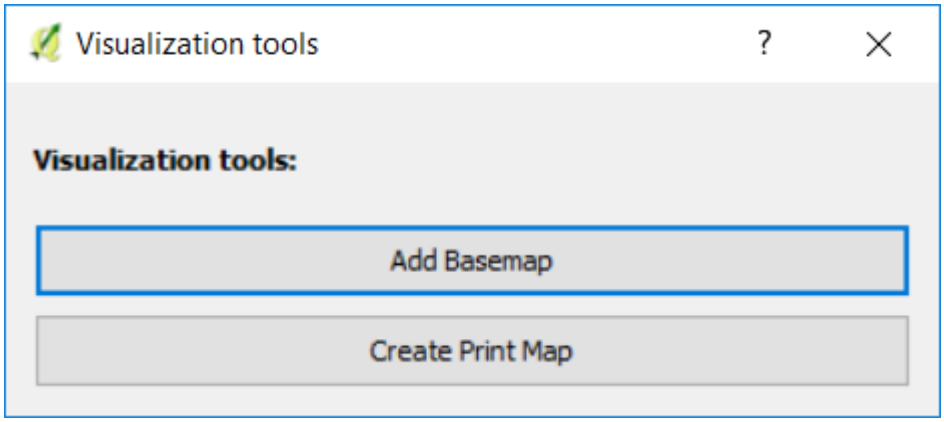
22.1 Adding a basemap

Basemaps are very useful as a reference for identifying specific locations in maps. When downloaded, Trends.Earth results are displayed on an empty QGIS project, which could limit the user ability for identifying know places in the landscape. To facilitate this process, you can use the Add Basemap tool which will load country and state boundaries, roads, rivers, cities, coastlines and water bodies with labels to the QGIS project.

1. To load the tool click on the visualizations tool icon on the Trends.Earth toolbar.



2. Click on Add basemap.

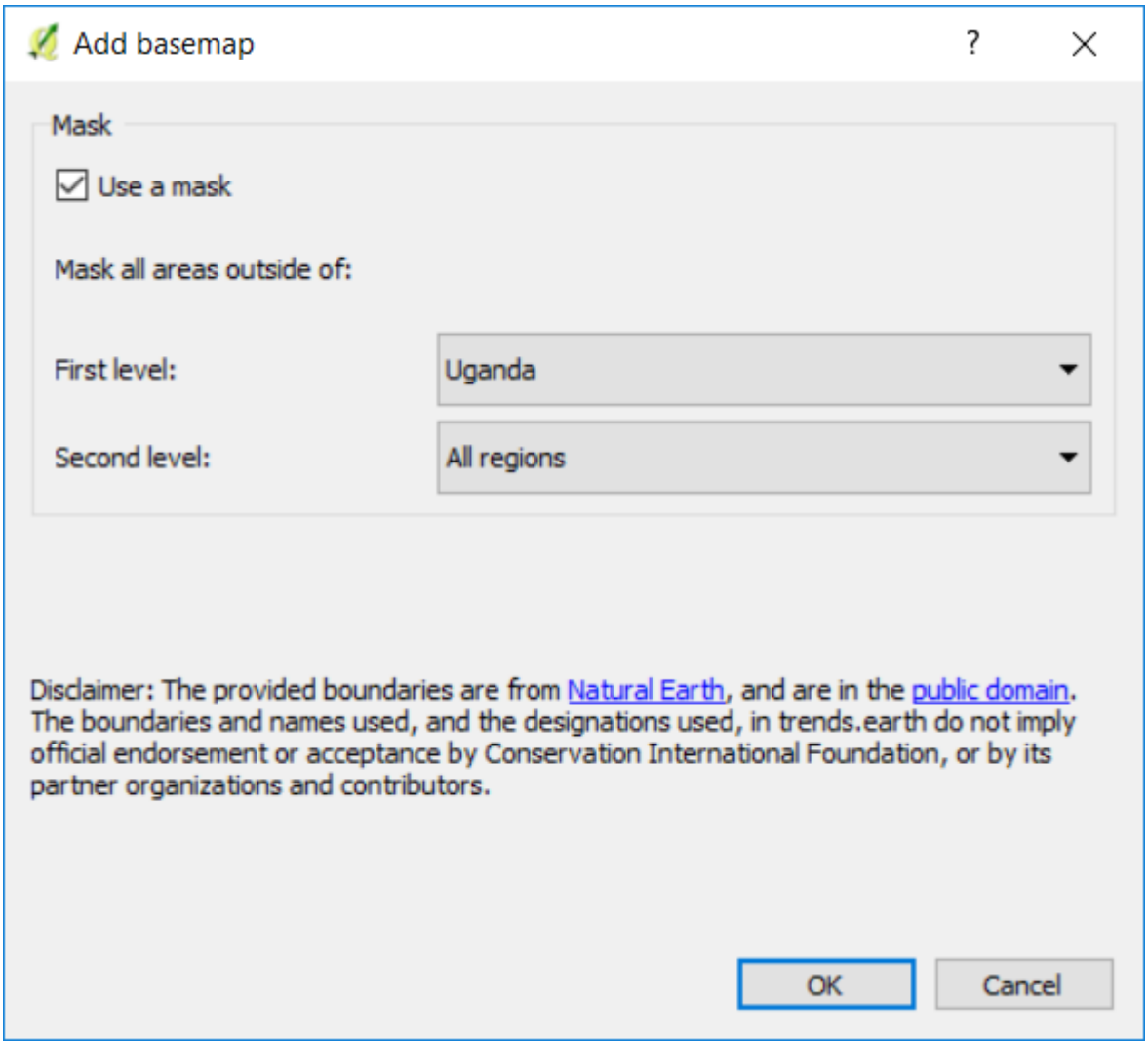


3. On the Add basemap window you can do one of two things:

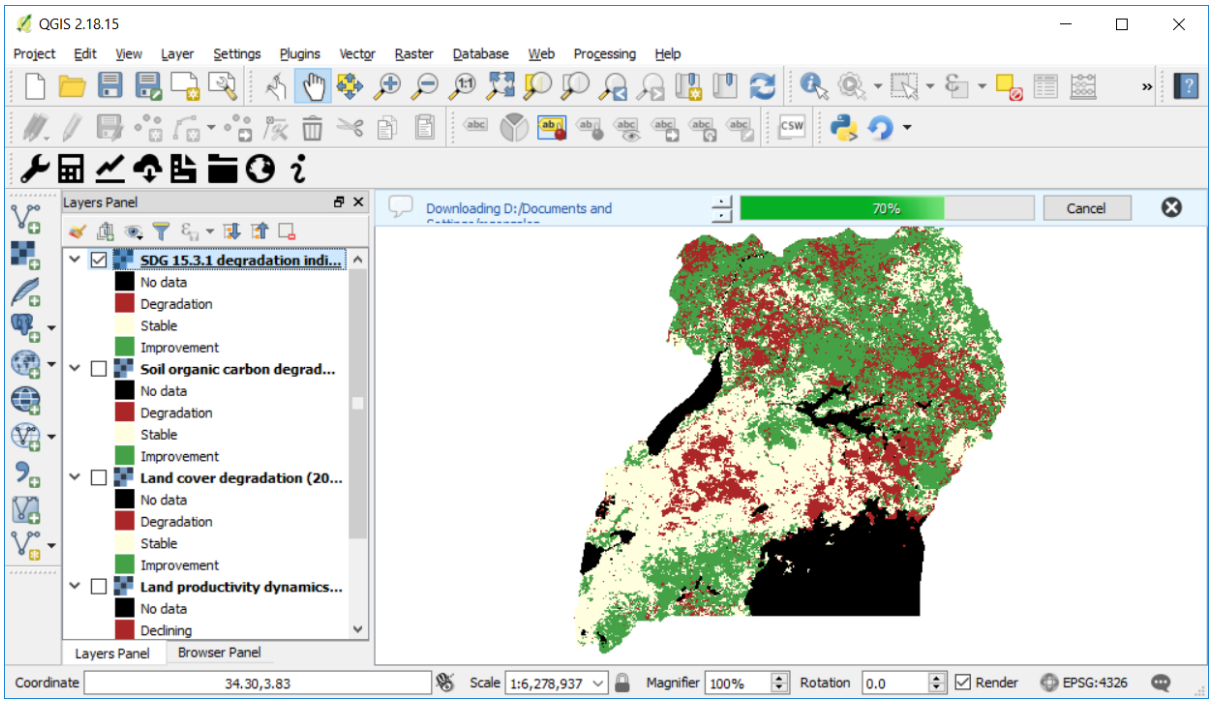
- Use a mask option selected will create a mask blocking all the information outside of the selected area. In this example, all the information outside of Uganda will not be displayed on the map.

This option is useful when displaying the sub-indicators downloaded from Trends.Earth, since the data download is not clipped to administrative boundaries (a bounding box is used instead). You can use first and second level administrative boundaries.

- Use a mask option not selected will load all the reference information, but no mask will be applied.

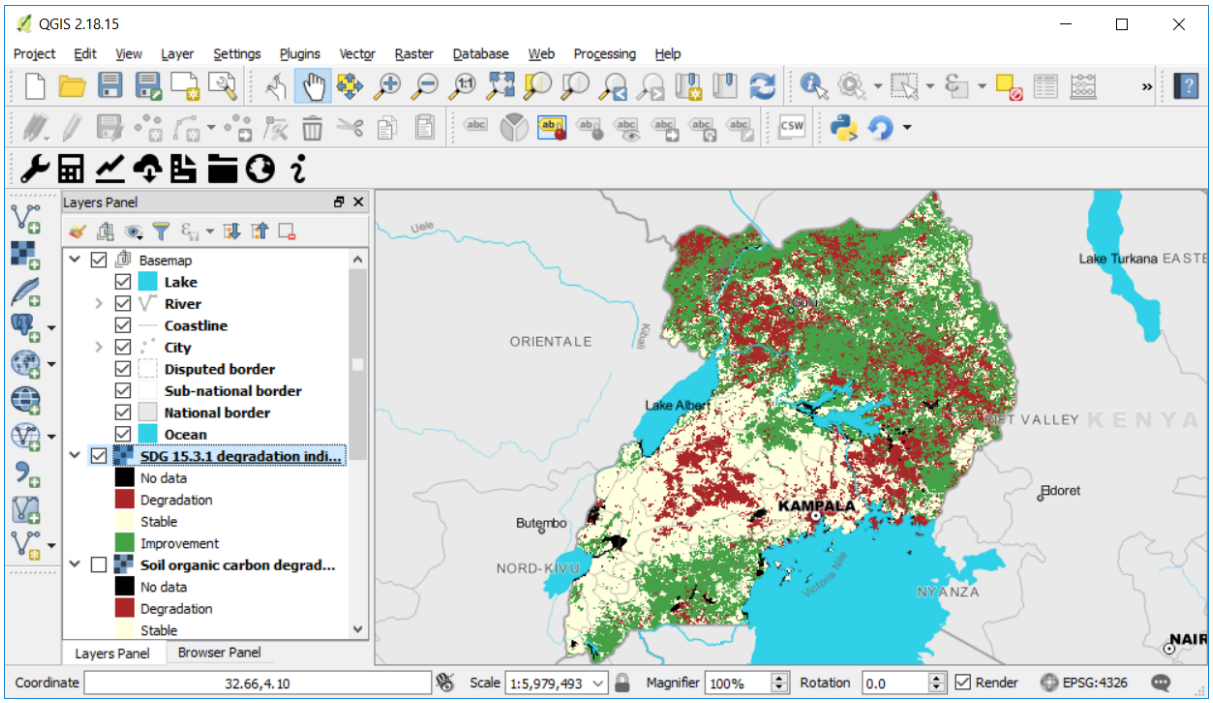


4. The first time you run this tool after installing Trends.Earth, the information will be downloaded from the Internet, so make sure you are connected. The progress bar will indicated the percentage of the task completed. The data will remain stored in your computer for future use.



5. Once the basemap is loaded, you will notice the information added to the map and to the Layer panel. The basemap has information for:

- Lake
- River
- Coastline
- City
- Disputed border
- Subnational border
- National border
- Ocean


QGIS 2.18.15
Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Help
Layers Panel
Basemap
Lake
River
Coastline
City
Disputed border
Sub-national border
National border
Ocean
SDG 15.3.1 degradation indi...
No data
Degradation
Stable
Improvement
Soil organic carbon degrad...
No data
Degradation
Stable
Layers Panel
Browser Panel
ORIENTALE
Lake Albert
Lake Turkana
KENYA
KAMPALA
Eldoret
Butembo
NORD-KIVU
NYANZA
Coordinate
32.66,4.10
Scale
1:5,979,493
Magnifier
100%
Rotation
0.0
Render
EPSG:4326

CHAPTER 23

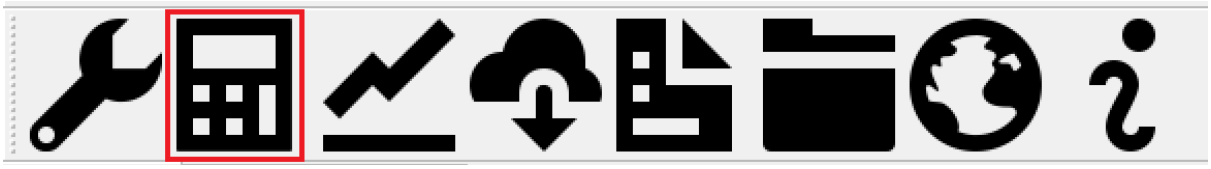
Compute SDG indicator

- Objective: Learn to integrate the land cover, primary productivity and soil organic carbon sub-indicators to compute SDG 15.3.1 in raster format and tabular outputs with areas estimated.
- Estimated time of completion: 20 minutes
- Internet access: Not required

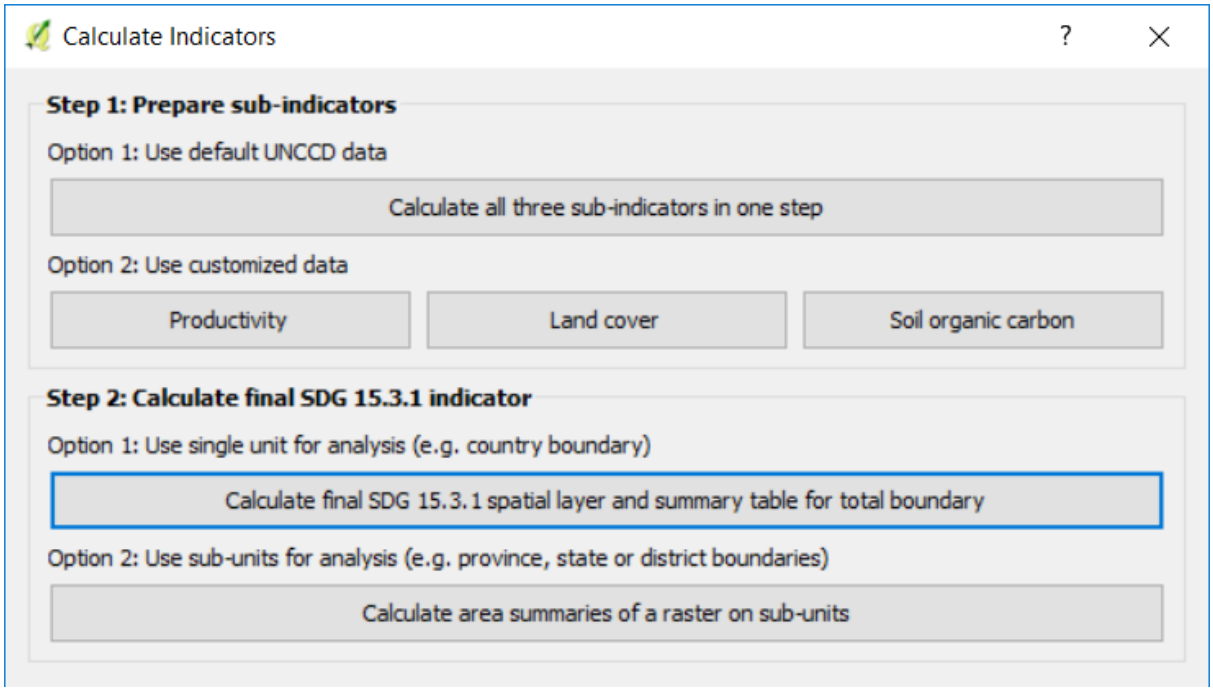
Note: Download this page as a PDF for offline use

Note: You will need to have previously computed the land cover, soil organic carbon and land productivity indicators prior to running this tool. If you have not, please refer to the following specific tutorials to compute them: Run 1-step subindicators, Use custom land cover data, Use custom productivity data, and Use custom soil data.

1. Search for the Trends.Earth toolbar within QGIS, and click on the Calculate icon ( ).



2. The Calculate Indicators menu will open. In that window, click on Calculate final SDG 15.3.1 spatial layer and summary table for total boundary button found under Step 2 - Option 1.



3. In the Input tab you will select each of the input layers needed for computing the final SDG 15.3.1. You ave the option of using Trends.Earth land productivity or UNCCD default data. In this case select UNCCD default data.

Note: Refer to the SDG Indicator 15.3.1 section of this manual to learn about the Trends.Earth productivity indicators developed following the UNCCD Good Practice Guidance (GPG).

---

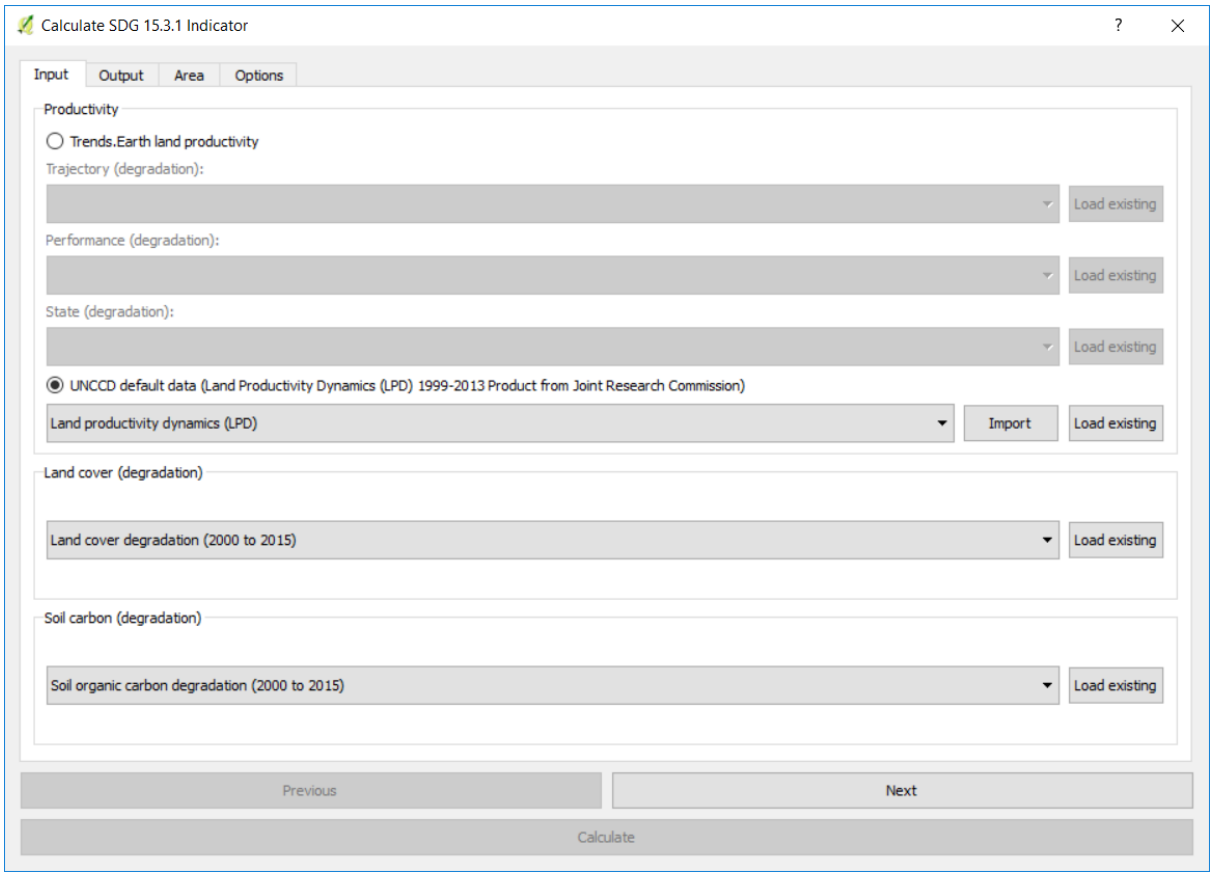
4. If you have the sub-indicators loaded into the QGIS map, the tool will recognize them and they will show up pre-filled in each corresponding section.

Note: If you have more than one layer loaded into the map per sub-indicator (for example, land cover change computed with default and also with custom data) make sure to check that the one being used to compute the final SDG is the one you want.

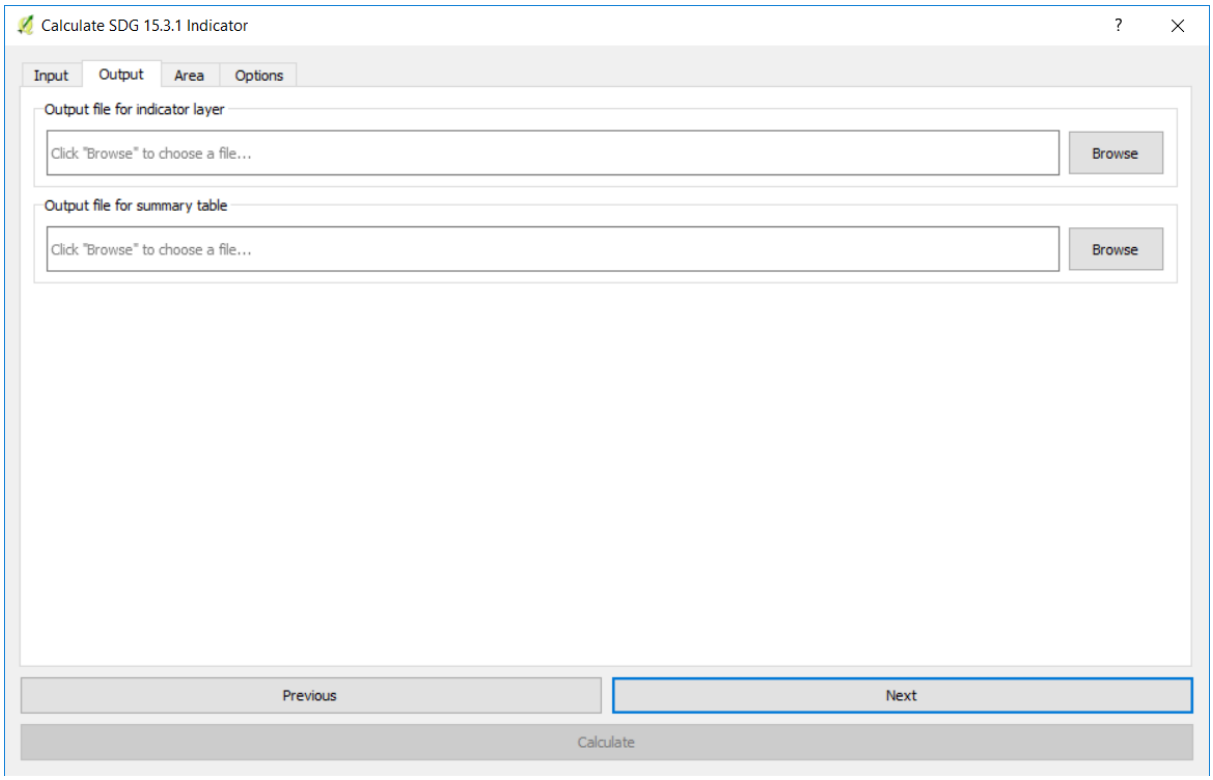
---

5. If the sub-indicators are not loaded in your QGIS map, then click Load existing next to each of the sub-indicators sections, and nagivate to the folder where you stored them in your computer.

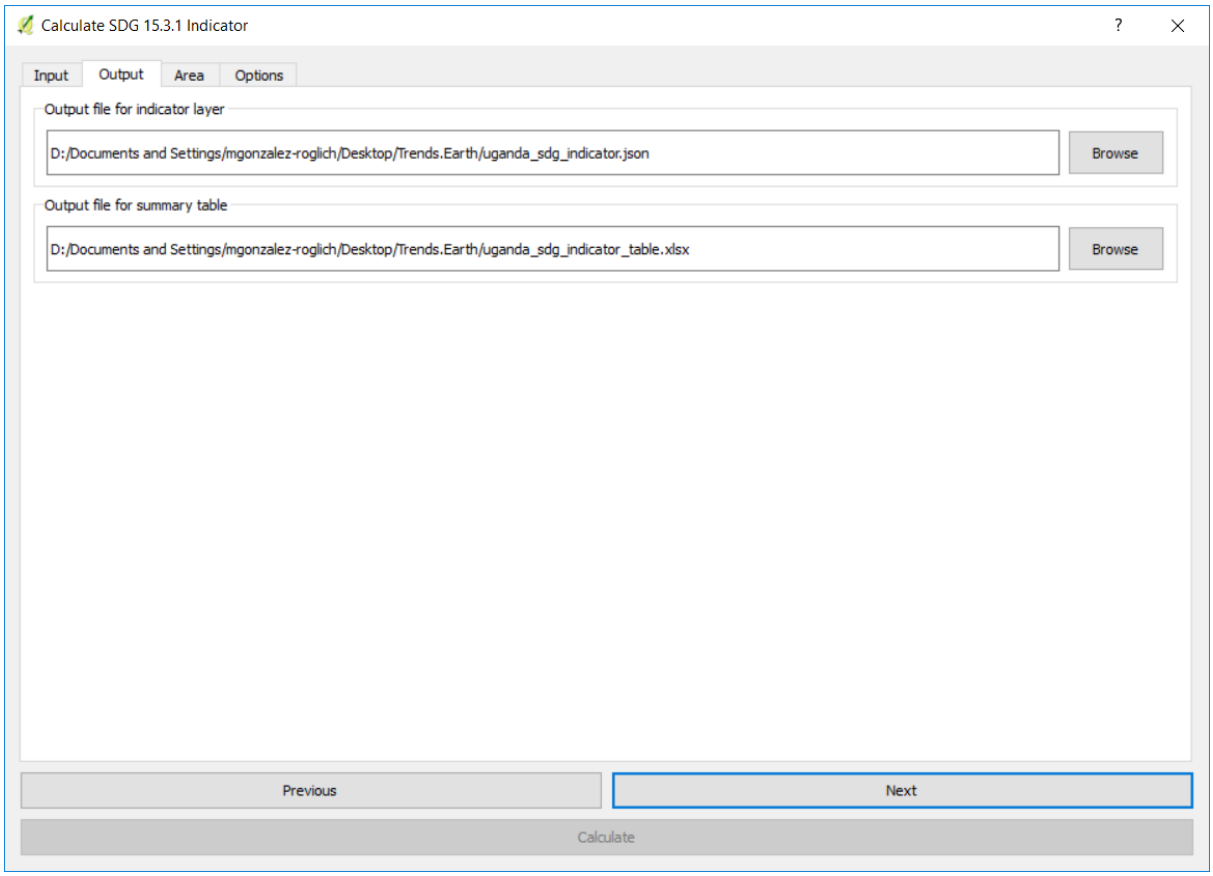
   When done selecting inputs, click Next.



6. In the Output tab you will need to define the name and location for the final SDG 15.3.1 indicator and the summary table. Click Browse next to each of them to select the output location and to define names.



7. When done, click Next.



8. In the Area tab define the area of analysis. There are two options:

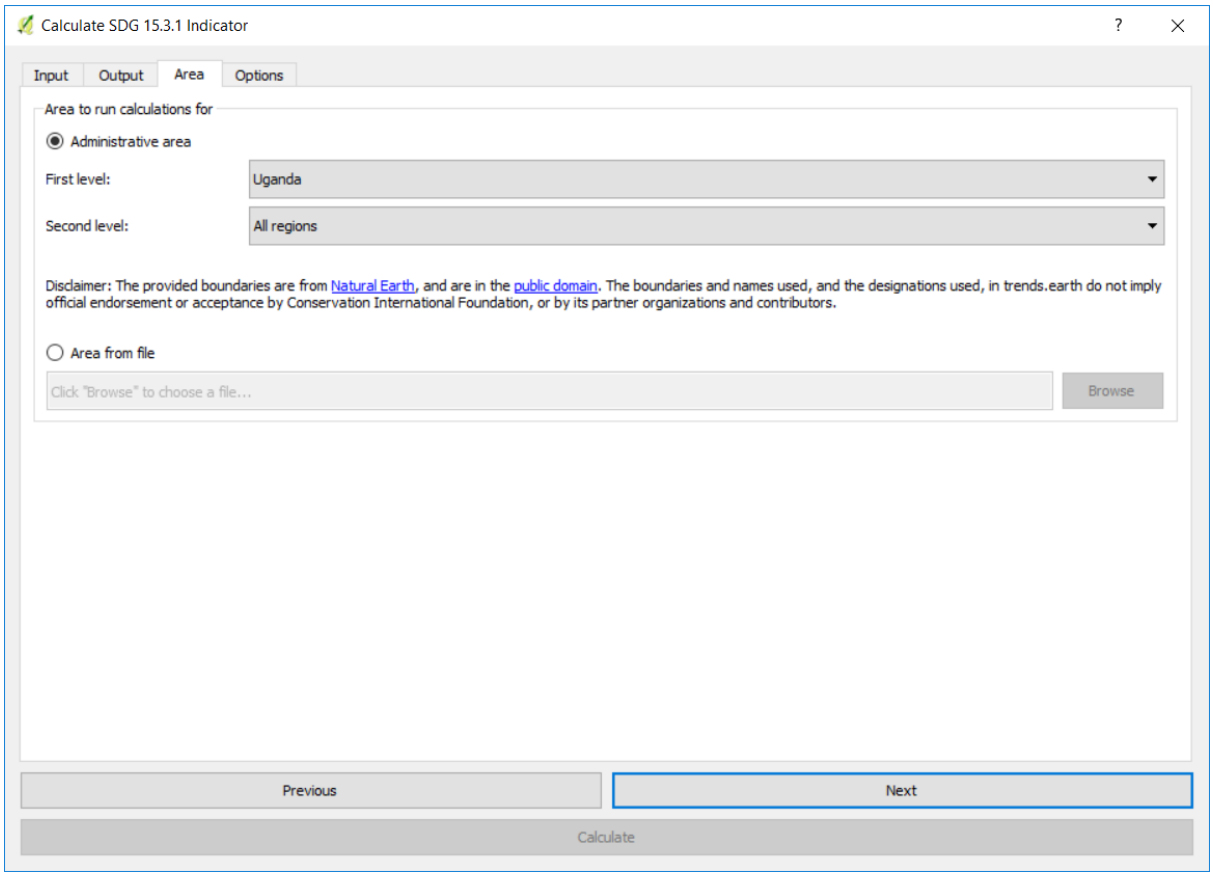
- Use provided country and state boundaries: If you want to use this option make sure the Administrative area option is highlighted, and then select the First Level (country) or Second Level (state or province depending on the country).

Note: The Natural Earth Administrative Boundaries provided in Trends.Earth, are in the public domain. The boundaries and names used, and the designations used, in Trends.Earth do not imply official endorsement or acceptance by Conservation International Foundation, or by its partner organizations and contributors.

If using Trends.Earth for official purposes, it is recommended that users choose an official boundary provided by the designated office of their country.

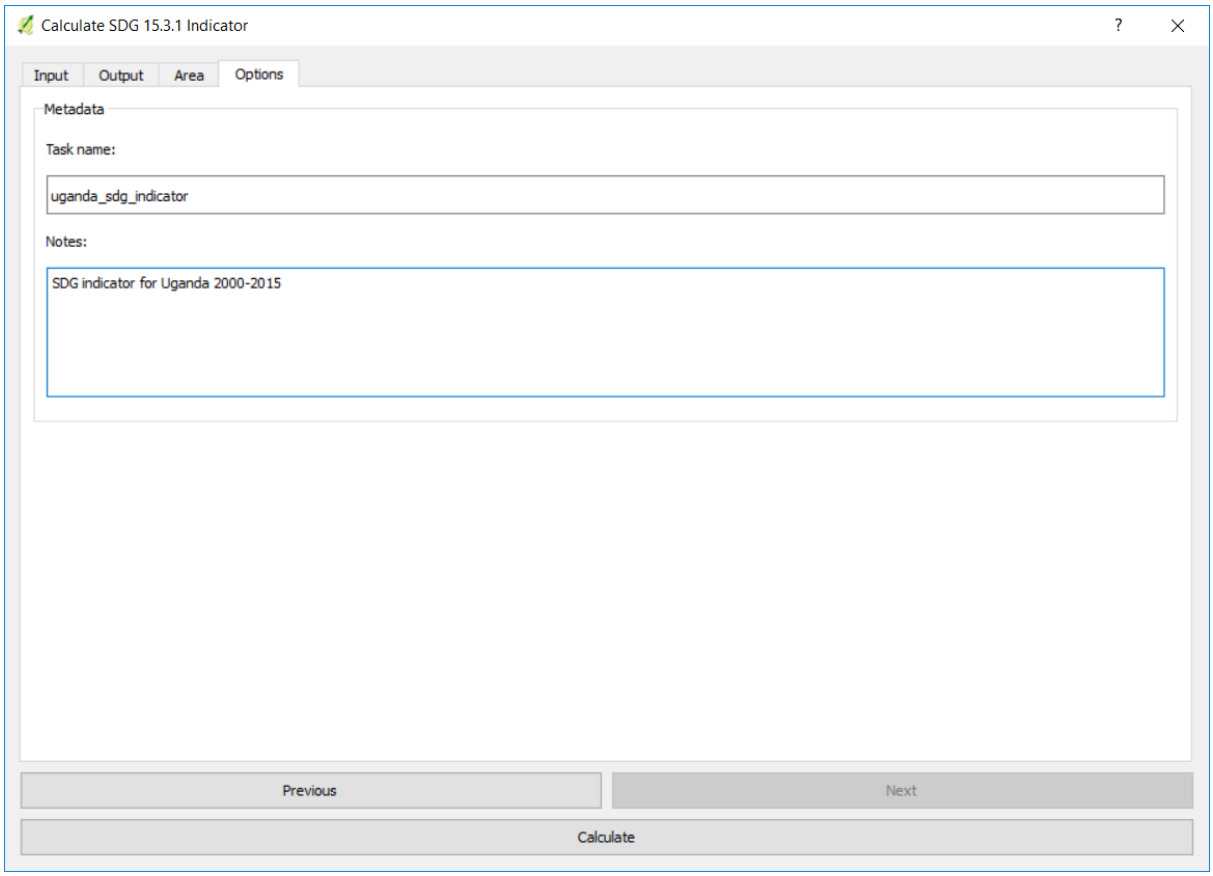
- Use your own area file: If you want to use your own area of analysis, make sure the Area from file option is highlighted. Then click Browse and navigate to the folder in your computer where you have the file stored.

When you have selected the area for which you want to compute the indicators, click Next.



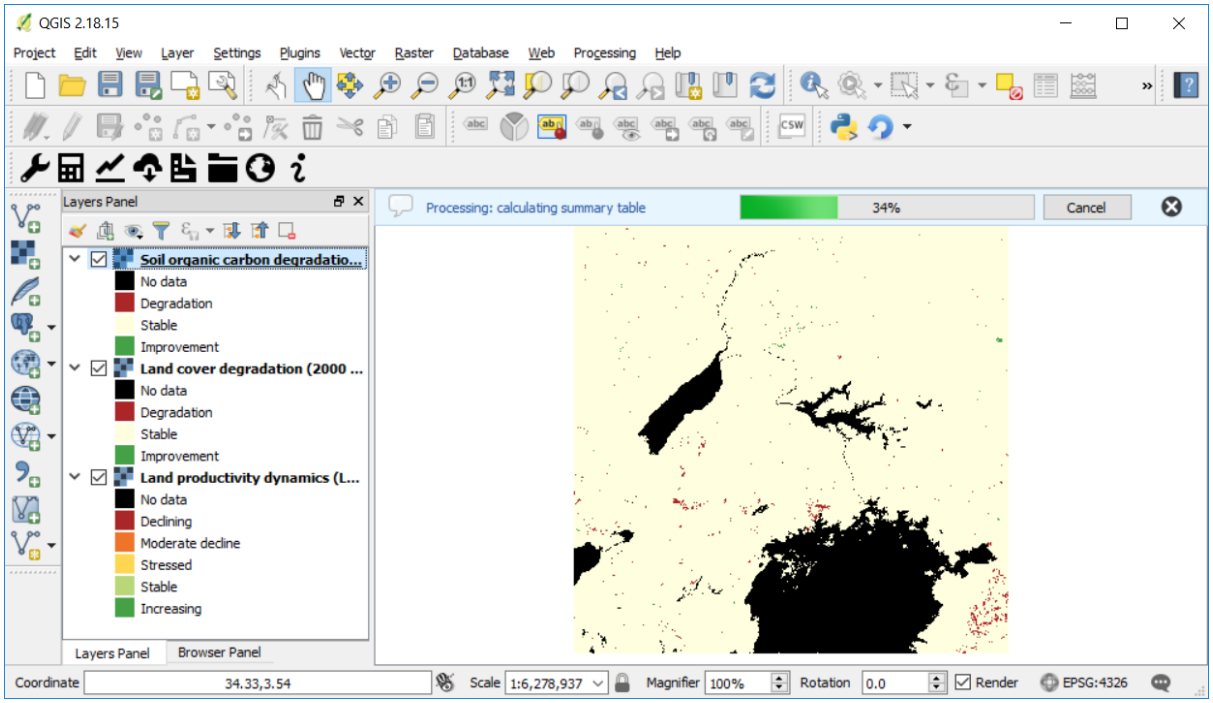
9. In the Options tab you can define the Task name and make some Notes to identify the analysis you are running. What information to indicate is optional, but we suggest noting:

- Area of analysis
- Dates
- Indicators run

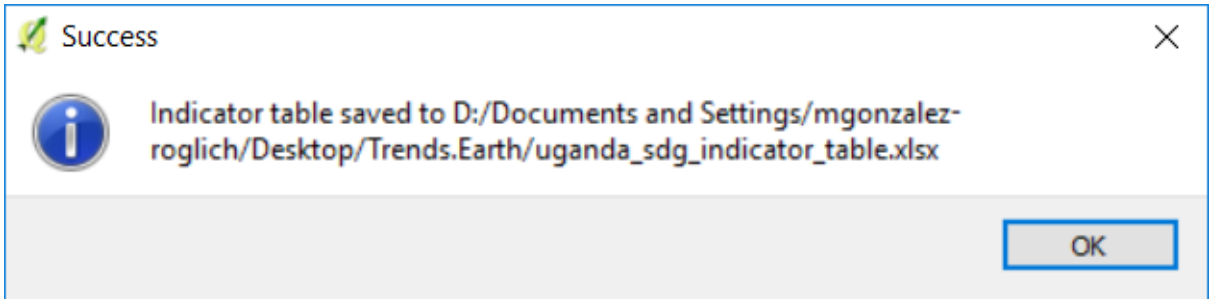


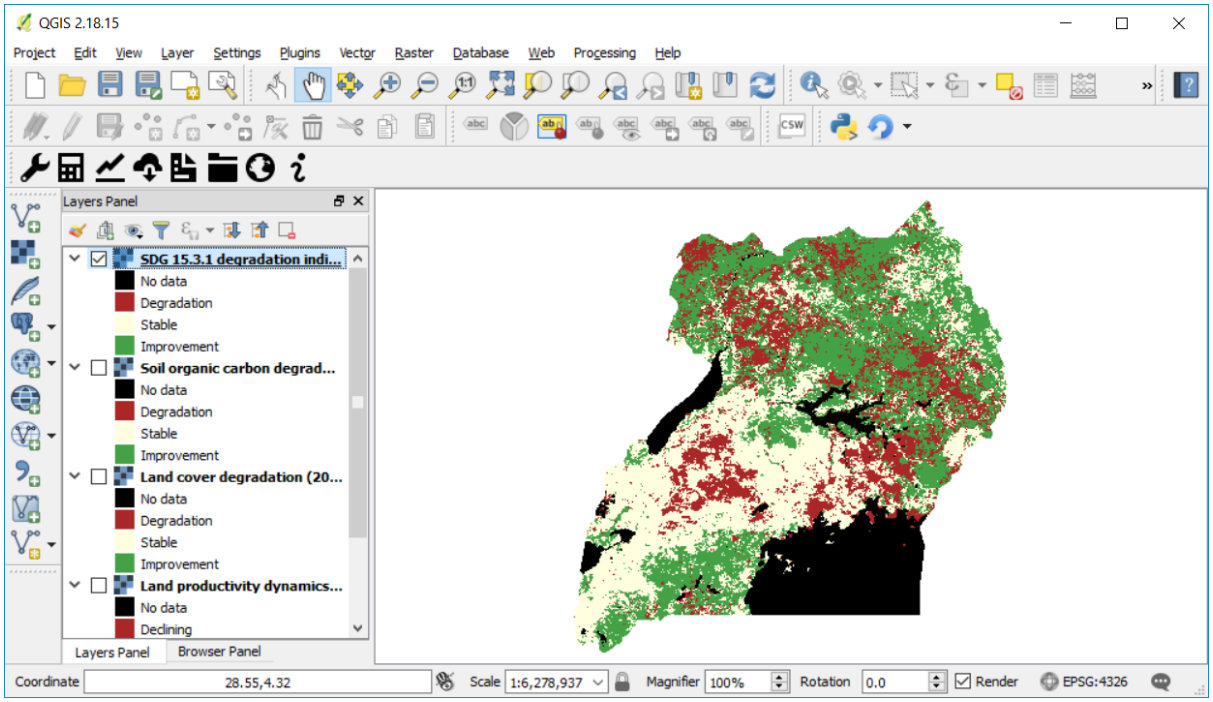
10. When done, click Calculate. A light blue bar will temporarily show, indicating that the task was successfully submitted.

Note: This analysis will be run in your local computer, so the processing time will depend on the size of the area, resolution of the data, and the processing capabilities of your computer. Do not close your computer or put it to sleep while running, because the analysis will fail.



11. When the analysis is completed a Success message will notify you and the indicator will be loaded to the map.





Note: Refer to the Interpreting summary table section of this manual to learn how to open and interpret the information in the summary table created by this analysis.

CHAPTER 24

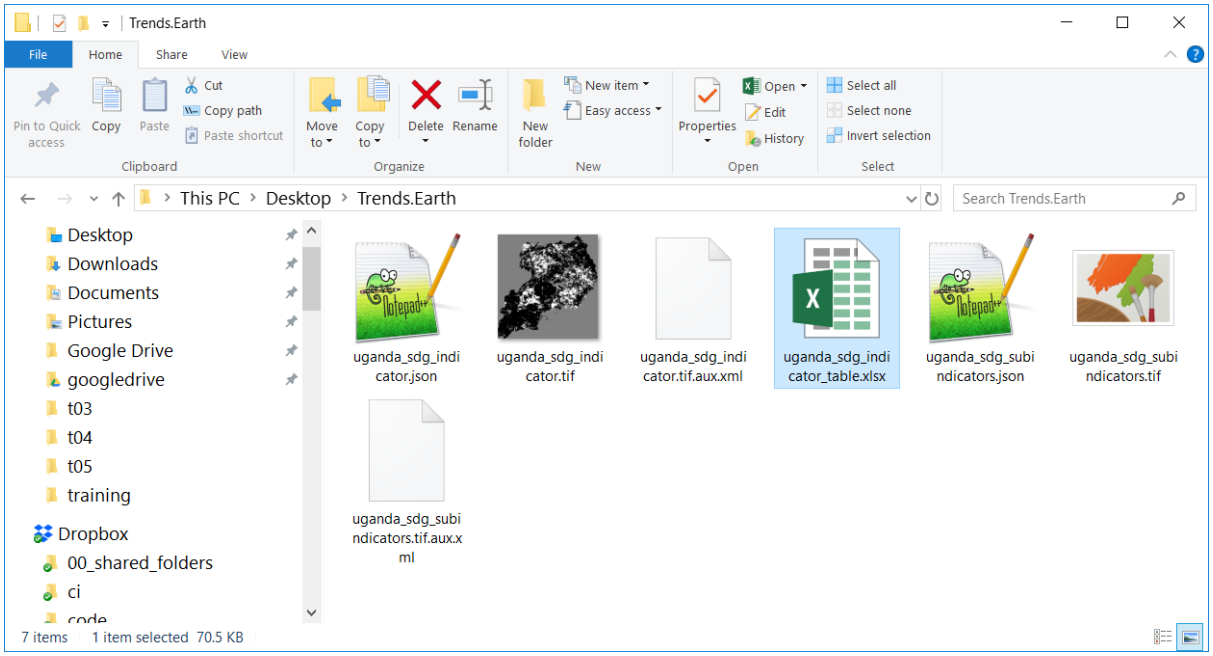
Interpreting summary table

- Objective: Learn how to open and interpret the summary tables produced by Trends.Earth when computing the final SDG 15.3.1 layer.
- Estimated time of completion: 25 minutes
- Internet access: Not required

Note: Download this page as a PDF for offline use

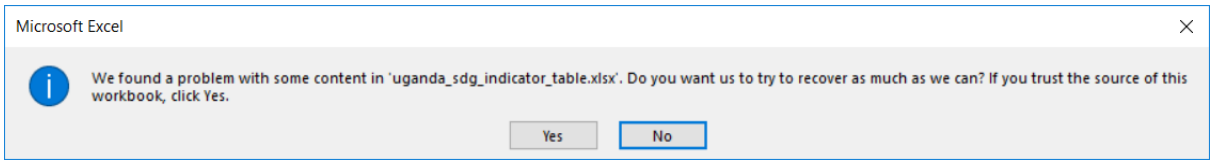
Note: You will need to have previously computed SDG 15.3.1 using the Calculate final SDG 15.3.1 spatial layer and summary table for total boundary tool. Refer to the section Compute SDG indicator for instructions on how to run the analysis.

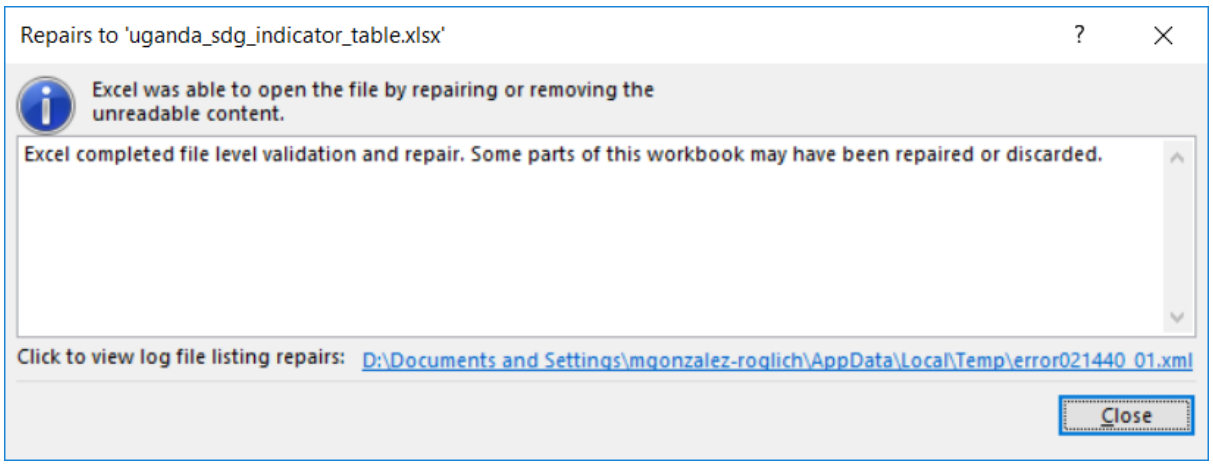
1. When you computed SDG 15.3.1 an Excel file was created with the summary table. Browse to that folder and double click on the file to open it.



If you are using Microsoft Excel, you may see the following error messages pop-up. Click Yes on the first one and OK* on the second one. We are currently working trying to identify where the error comes from, but the file is fully functional.

If you are using LibreOffice or OpenOffice, the file will load with no errors.

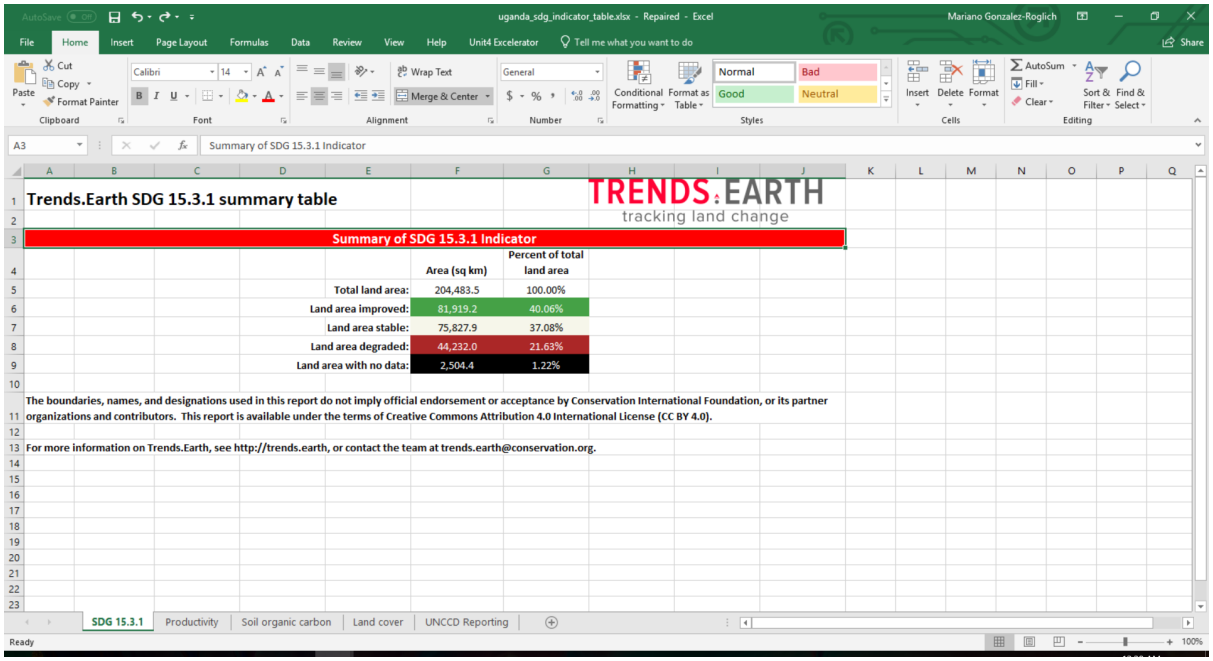




2. The summary table file contains 5 tabs, which you can explore by clicking on each of the different names the bottom of the screen: SDG 15.3.1, Productivity, Soil organic carbon, Land Cover and UNCCD Reporting.

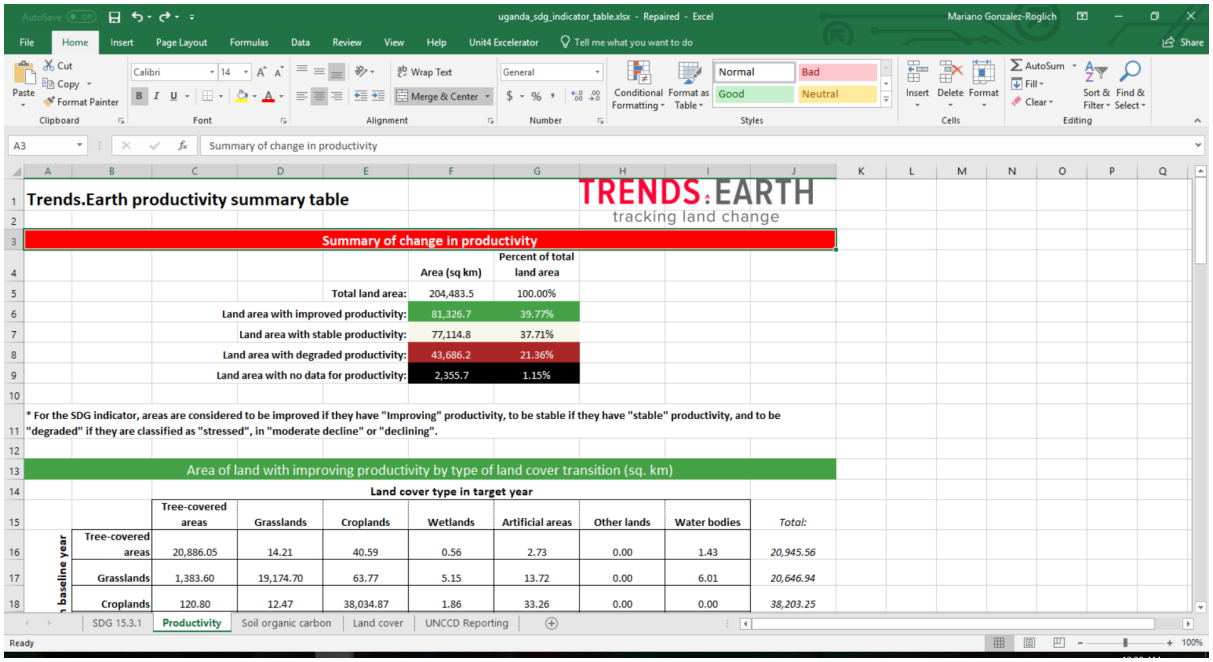
3. In the SDG 15.3.1 tab you will find the area calculations derived from the indicator map you explored in QGIS.

   For the area you run the analysis, you will see the total land area (excluding water bodies): land that experienced improvement, which remained stable, areas degraded, and also information on the areas with no data for the period selected. No data in the SDG 15.3.1 is an indication of no data in some of the input datasets used in the analysis.



3. In the Productivity tab you will find at the top, a similar summary as previously explained, but in this case representing the results of the land productivity sub-indicator alone.

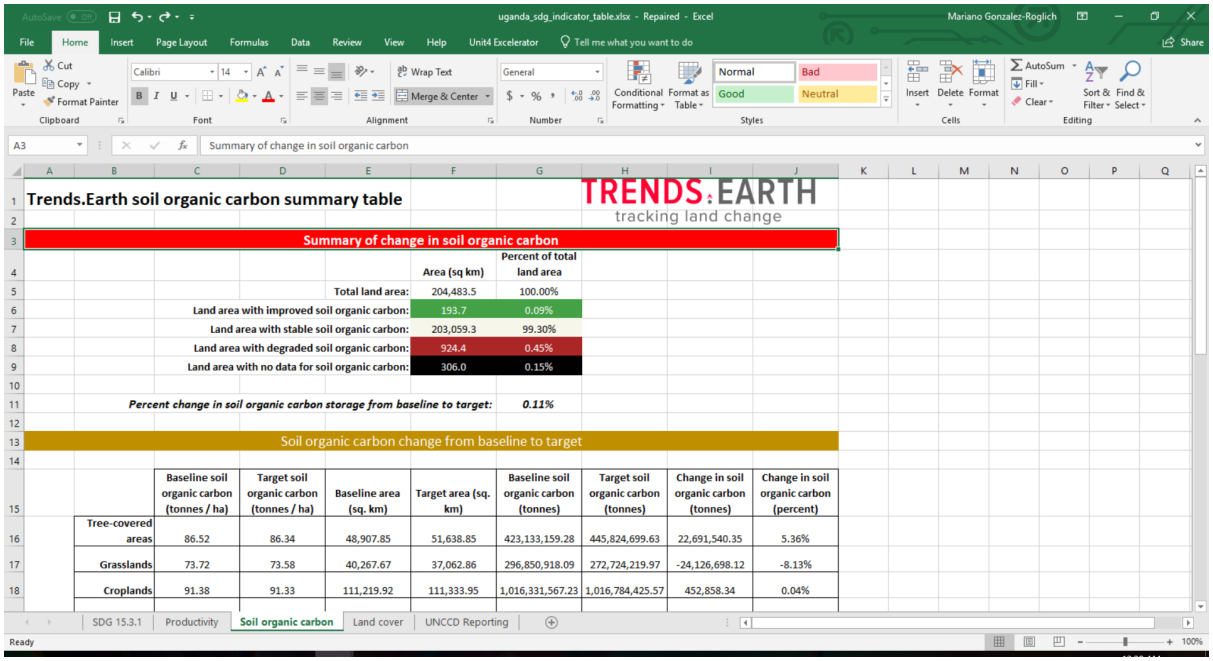
   In the sections below you will find two tables, each containing area information (in sq. km) for each of the land cover transitions found in the study are during the period analyzed broken by each of the 5 final land productivity classes: Increasing, Stable, Stable but stressed, Early signs of decline, and Declining.



4. In the Soil organic carbon tab you will find at the top, a similar summary as previously explained, but in this case representing the results of the soil organic carbon sub-indicator alone.

   In the sections below you will find two tables:

   - The first one contains information on changes in carbon stocks from the baseline (initial year of analysis) to the target (final year of analysis).
   - The second presents information soil organic carbon change from baseline to target by type of land cover transition (as percentage of initial stock).



Trends.Earth soil organic carbon summary table

TRENDS.EARTH tracking land change

Summary of change in soil organic carbon

	Area (sq km)	Percent of total land area
Total land area:	204,483.5	100.00%
Land area with improved soil organic carbon:	193.7	0.09%
Land area with stable soil organic carbon:	203,059.3	99.30%
Land area with degraded soil organic carbon:	924.4	0.45%
Land area with no data for soil organic carbon:	306.0	0.15%

Percent change in soil organic carbon storage from baseline to target: *0.11%*

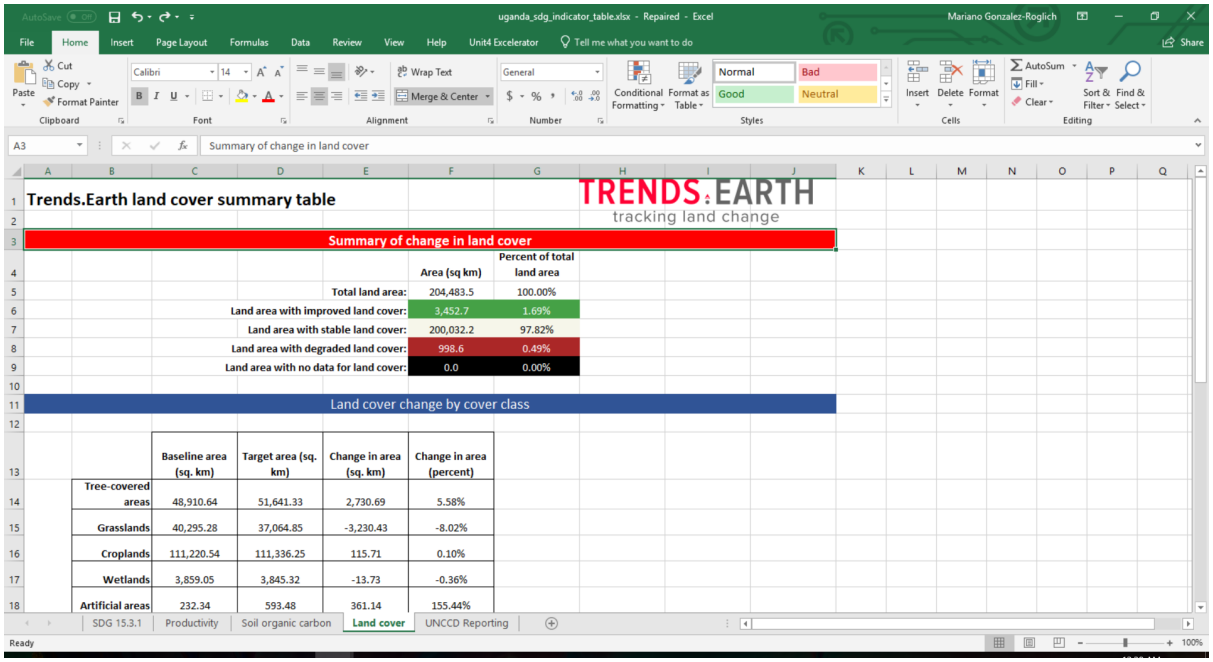
Soil organic carbon change from baseline to target

	Baseline soil organic carbon (tonnes / ha)	Target soil organic carbon (tonnes / ha)	Baseline area (sq. km)	Target area (sq. km)	Baseline soil organic carbon (tonnes)	Target soil organic carbon (tonnes)	Change in soil organic carbon (tonnes)	Change in soil organic carbon (percent)
Tree-covered areas	86.52	86.34	48,907.85	51,638.85	423,133,159.28	445,824,699.63	22,691,540.35	5.36%
Grasslands	73.72	73.58	40,267.67	37,062.86	296,850,918.09	272,724,219.97	-24,126,698.12	-8.13%
Croplands	91.38	91.33	111,219.92	111,333.95	1,016,331,567.23	1,016,784,425.57	452,858.34	0.04%

5. In the Land cover tab you will find at the top, a similar summary as previously explained, but in this case representing the results of the land cover change sub-indicator alone.

   In the sections below you will find two tables:

   - The first contains information on land cover change by cover class (sq, km and %).
   - The second contains information on land area by type of land cover transition (sq. km).



Trends.Earth land cover summary table

TRENDS.EARTH tracking land change

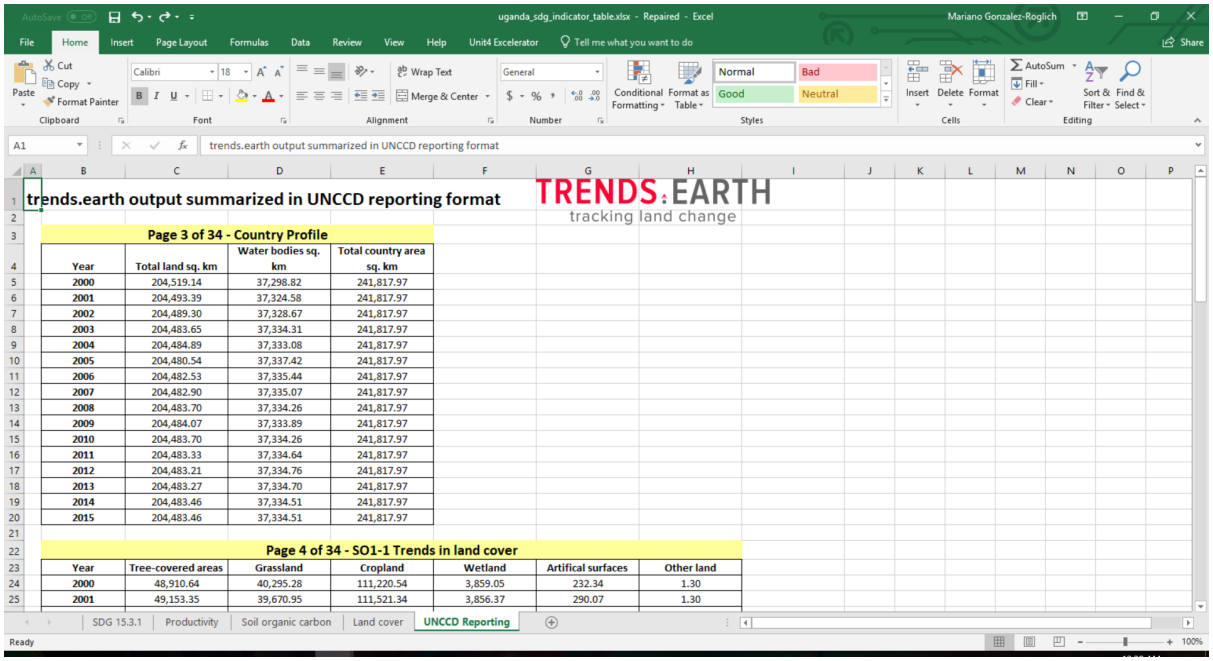
Summary of change in land cover

	Area (sq km)	Percent of total land area
Total land area:	204,483.5	100.00%
Land area with improved land cover:	3,452.7	1.69%
Land area with stable land cover:	200,032.2	97.82%
Land area with degraded land cover:	998.6	0.49%
Land area with no data for land cover:	0.0	0.00%

Land cover change by cover class

	Baseline area (sq. km)	Target area (sq. km)	Change in area (sq. km)	Change in area (percent)
Tree-covered areas	48,910.64	51,641.33	2,730.69	5.58%
Grasslands	40,295.28	37,064.85	-3,230.43	-8.02%
Croplands	111,220.54	111,336.25	115.71	0.10%
Wetlands	3,859.05	3,845.32	-13.73	-0.36%
Artificial areas	232.34	593.48	361.14	155.44%

6. In the UNCCD Reporting tab you will find five tables containing similar information as the one presented in the previous tabs, but in this case specifically formatted to match the reporting template required by the UNCCD. Each table indicates at the top the page number and section of the template the information is referring to.



uganda_sdg_indicator_table.xlsx - Repaired - Excel

trends.earth output summarized in UNCCD reporting format

TRENDS.EARTH
tracking land change

Page 3 of 34 - Country Profile

Year	Total land sq. km	Water bodies sq. km	Total country area sq. km
2000	204,519.14	37,298.82	241,817.97
2001	204,493.39	37,324.58	241,817.97
2002	204,489.30	37,328.67	241,817.97
2003	204,483.65	37,334.31	241,817.97
2004	204,484.89	37,333.08	241,817.97
2005	204,480.54	37,337.42	241,817.97
2006	204,482.53	37,335.44	241,817.97
2007	204,482.90	37,335.07	241,817.97
2008	204,483.70	37,334.26	241,817.97
2009	204,484.07	37,333.89	241,817.97
2010	204,483.70	37,334.26	241,817.97
2011	204,483.33	37,334.64	241,817.97
2012	204,483.21	37,334.76	241,817.97
2013	204,483.27	37,334.70	241,817.97
2014	204,483.46	37,334.51	241,817.97
2015	204,483.46	37,334.51	241,817.97

Page 4 of 34 - SO1-1 Trends in land cover

Year	Tree-covered areas	Grassland	Cropland	Wetland	Artifical surfaces	Other land
2000	48,910.64	40,295.28	111,220.54	3,859.05	232.34	1.30
2001	49,153.35	39,670.95	111,521.34	3,856.37	290.07	1.30

SDG 15.3.1 | Productivity | Soil organic carbon | Land cover | UNCCD Reporting

Part V

Videos

CHAPTER 25

Video Overviews

- Installing QGIS (English)
- Toolbox installation (English)
- Toolbox setup (English)
- Download data (English)
- Calculate Indicators - Productivity Part I (English)
- Calculate Indicators - Productivity Part II (English)
- Calculate Indicators - Land cover Part I (English)
- Calculate Indicators - Land cover Part II (English)
- Calculate Indicators - Soil Carbon (English)
- Visualizing indicators (English)
- Plotting time series data (English)
- Reporting SDG and UNCCD (English)
- Interpreting results (English)